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Washington, D. C.: PAUL WOOTON

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Work-Relief Funds and The Mineral Industries

IN VIEW of the uncertainty about the fate of the Administration's proposal to spend nearly five billion dollars on nation-wide work-relief projects, it may be idle to speculate on the desirability of allocating part of that huge sum to the mineral industries. The President has already stated to Congress, however, that a substantial portion of the fund would be used for objectives suggested in the report of the National Resources Board, of which the recommendations of the Planning Committee for Mineral Policy formed so conspicuous and well considered a part (*E. & M. J.* Jan., 1935). We may well inquire, therefore, what consideration the mineral industries could logically ask and expect of the Government in the expenditure of some of this money, if and when it becomes available.

As a basis for action we suggest the mineral policy report, particularly that part dealing with minerals in which the United States is deficient. The Planning Committee recommended spending federal funds for field surveys and process investigations to determine our national resources in "deficiency" minerals. If the United States is to adopt a policy for the orderly development of its mineral resources, it is logical to expect the Government itself to further that policy now by spending part of its work-relief money in the mineral industries. This would serve the dual purpose of providing relief and taking a careful inventory of mineral resources of special national significance.

Specifically we make the following proposals: First, that money be placed at the disposal of the Bureau of Mines and the Geological Survey for exploration in search of sources of deficient minerals mentioned in the Planning Committee's report; also for additional sources of minerals of inadequate supply and for process research that may make low-grade supplies of these minerals commercially useful. Second, that funds be allocated to those mining states in which planning boards, geological surveys, mining bureaus, or similar state agencies have prepared plans for local mineral development that will create employment and encourage private investment in the mining industry.

There are two excellent patterns for work that could be directed by the Bureau of Mines and Geological Survey. The first is found in the remarkable story of our domestic potash industry, which is outlined briefly on page 127. As a result of several years of careful scientific work by the Survey, the existence of potash deposits was proved to a point where private enterprise was encouraged to spend money to establish an industry. The Bureau subsequently aided in process development. A second instance is found in the work of both federal agencies, particularly the Survey, in making an inventory of the mineral resources of the region surrounding Boulder Dam. As just published by the Bureau of Reclamation, this report lists and maps the important occurrences and production of ferrous, nonferrous, and non-metalliferous ores and minerals within a radius of 200 miles of Boulder Dam and forms an excellent background for private prospecting and development. Both of these federal

projects could well be taken as patterns for more extensive work to inventory the mineral resources of the nation. In addition, there is the desirability of re-surveying old mining districts where revival is now in evidence and where new knowledge would be useful to the mining industry.

Appropriations to mining states should depend on their ability to present reasonable programs of work relief. Some have been forehanded enough to prepare such programs, ready for immediate approval. Others are not so advanced, but should devise plans that will merit consideration. In order to correlate federal and state projects, the latter should be subject to federal approval by the Bureau and the Survey, although administration would remain in the hands of state authorities.

We believe that the mineral industries are in a strategic position to use work-relief funds in a way that will insure national as well as local return for money expended. Both human and material resources can be conserved and rehabilitated by well-conceived projects that will serve the future as well as the immediate needs. No industry is in a better position to use work-relief funds in the national interest.

A Gift From the Tax Gatherer

TAXATION being inescapable, anything that will lighten its burden is a boon, and the simpler its calculation the better, even though this tend to expedite the settlement of the bill. In the last decade much has been done to clarify the questions that have harassed mining companies when computing income tax. Those centering on the allowances for depreciation and depletion have been largely settled. The Revenue Act of 1932 permitted the taxpayer to elect whether depletion should be computed on a percentage basis or under the general rule, such election to control for all years thereafter. The Act of 1934 again extended this permission, providing that the taxpayer must state his choice in making his return for 1934 and that the election so made is to control for all succeeding years. Such return is due on the 15th of the present month.

This provision gains new interest in view of a very recent ruling of the Bureau of Internal Revenue that mine development expenditures of *producing* mines are not capital costs which are required to be classified as "capital recoverable through depletion" allowances and which would therefore be added to the first cost of the ore. Instead, they are to be treated as operating expenses deductible in the year in which the ore benefited by such expenditures is produced and sold and to the extent to which they can be allocated to that year's operations. Had these expenditures been held to be capital costs recoverable through depletion, mine taxpayers who elect to take percentage depletion would automatically lose the privilege of deducting this deferred development item separately, and their tax would be correspondingly higher.

Repercussions of Reciprocity

IN THE bilateral trade agreement between the United States and Brazil the mining industry feels the first repercussion of the State Department's policy to encourage the removal of barriers to international trade. Our Washington correspondent outlines the conditions of the treaty and reflects official sentiment which is likely to find expression as a national policy on mineral resources.

In planning a national mineral policy the problem of insuring to the country an adequate supply of those minerals that are needed in both peace and war, but of which the domestic resources are limited or wholly lacking, must inevitably be considered. Its neglect may be costly. Confidence in a continued ability to purchase such supplies abroad may prove, in a crisis, to have been misplaced. On the other hand, stimulation by tariff protection or subsidy of production from limited ore reserves promotes their early exhaustion and increases the price of the product to the consumer, although it may also foster new discovery, with possibly a consequent lowering of price. If such stimulation be frowned upon, complete assurance of needed supplies in the face of deficient resources is to be won only by accumulating and maintaining a mined stock on hand, or by keeping the deficient reserves unmined but in a state of easy accessibility, or by employing both of these expedients. Thus may be summarized, once again, the problem of essential but deficient minerals. In the present attitude of the Government toward conservation of natural resources, conflicting policies are likely to be weighed in the balance of national welfare and decision rendered accordingly.

Mining Gold on Carson Hill

Stamp mill and office of Carson Hill Gold Mining Corporation, Melones, Calif. The Stanislaus River is in the foreground

Today the prime objective of this California enterprise is to make a profit on low-grade ore, which involves keeping mill tonnages up and expenses down—Operations combine open-cut, glory-hole and underground work—The year 1848 saw the first production from this property

John A. Burgess

General Superintendent
Carson Hill Gold Mining Corporation
Melones, Calif.

THE ADVENTURE, romance, and strife of the California gold rush of the early days are typically depicted in the history of the Carson Hill mine. Interesting as the story is, only a few of the highlights can be touched upon here, and if apology is needed for introducing a technical description with a story of gold and the forty-niners, it is that the dramatic side of their history is ever present, consciously or subconsciously, in the thoughts of those concerned with these old mines.

In August, 1848, Jim Carson, with a group of fellow veterans of the Mexican War, prospecting in what is now Calaveras County, found gravel rich in gold in Carson Creek. As the result of their first six days' work they accumulated 186 oz. of gold apiece. Carson reported that they were "the happiest men on earth." Shortly afterward a man named John Hance traced this gold to its source on Carson Hill and located claims there along the outcropping quartz. Hance took in five partners, of whom Alfred Morgan was made president, and the mine has since been known as the Morgan mine. Morgan and his associates found rich ore and mined it until the notorious Billy Mulligan, a swashbuckling desperado, with a gang of ruffians, raided the mine and took forcible possession of the property. Mulligan's subsequent career led him into rotten politics in San Francisco. He was a gunman and a murderer, an all-round bad character, and he was finally shot to death by police in the St. Francis Hotel, in San Francisco. After holding the mine for nine months, in 1853 the outlaws were in turn ejected by a court order. Immense amounts of gold were mined and immense amounts were stolen. In 1854, a lump of gold was found that weighed 161 lb. avoirdupois. Later the mine was purchased and worked by James G. Fair, and still later was owned by his daughters, Mrs. Hermann Oelrichs and Mrs. W. K. Vanderbilt.

Ore from the Calaveras vein is being mined in an open cut with a power shovel by the Carson Hill company. The quartz outcrop may be seen on the right

In 1851 the South Carolina mine was discovered. The owners were unable to work the ore satisfactorily and they therefore leased it to a Mexican woman. Doña Elisa Martinez, beautiful and wealthy, had come to the mine to be near her lover, a member of Joaquin Murietta's gang. Of a practical as well as a romantic turn of mind, she took a lease in the South Carolina, paying 20 per cent royalty. She employed forty Mexican miners, worked the ore in hand mortars and arrastras, and made a fortune for herself. The owners received handsome dividends, but, finding that the mine was being "gouged," they refused to continue the lease.

At Robinson's Ferry, on the Stanislaus River, rich placer diggings also occurred, and quartz mining was started at the Stanislaus and Adelaide mines. It was in these mines that a new variety of gold telluride ore was found and named calaverite in honor of Calaveras County. Melonite, a nickel telluride, was also first found in the Stanislaus mine. Apparently it was named after the town of Melones.

All of these mines, including the Melones and the Calaveras mine, were acquired between 1918 and 1920 by the Carson Hill Gold Mines, Inc., the predecessor of the present operating company. The Melones mine prior to this time had operated on low-grade ore for

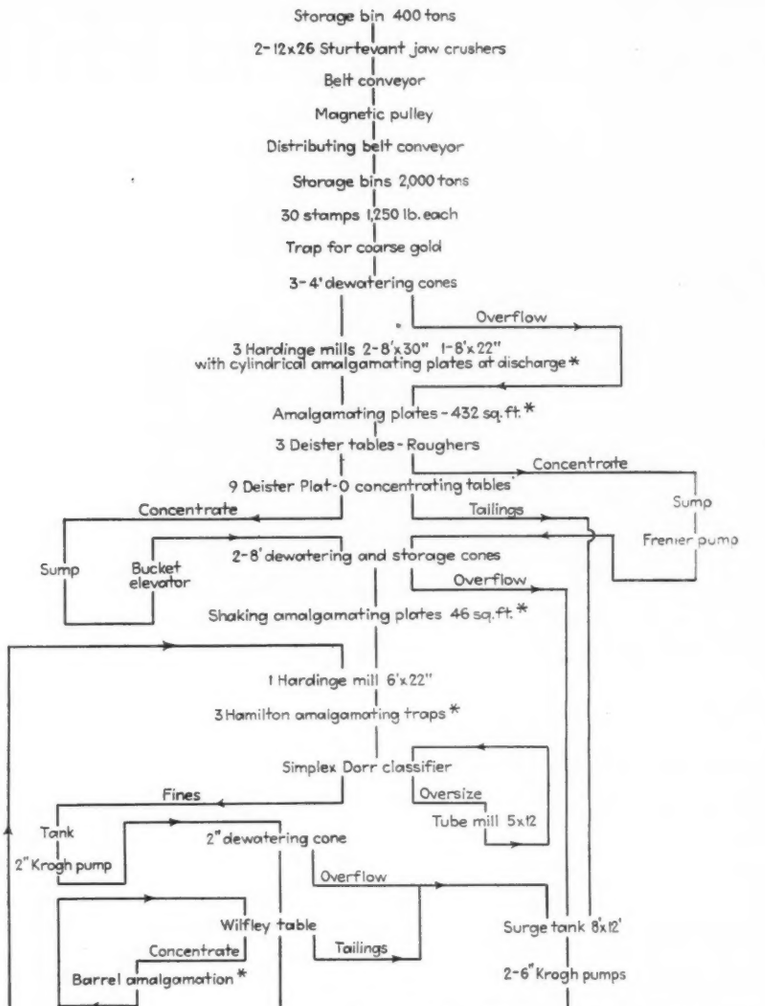


Fig. 1—Generalized flowsheet of stamp mill of Carson Hill Gold Mining Corporation at Melones. Amalgamation plays an important part

twenty years. After working for seven years and producing seven million dollars, the Carson Hill mine was shut down in December, 1926. A new company, the Carson Hill Gold Mining Corporation, purchased the property in 1930 and began the work of preparing the mine and mill for the resumption of operations in April, 1933. Mining and milling were resumed the following September, and have since continued.

The Carson Hill mine is situated on Carson Hill, in Calaveras County, about one mile north of the little town of Melones, formerly known as Robinson's Ferry. "Melones" is the Spanish word for melons. A variety of wild melon or gourd still grows on the hillsides, and "chispas" of gold were said to have the form of this melon's seeds. The property comprises about 1,500 acres, extending about a mile and a half northerly from Melones, and is about half a mile in width.

Geologically, the mine is in the Calaveras formation and is on the Mother Lode. As is generally known, the Mother Lode is not a continuous quartz vein, but is a belt of schistose and slaty rocks in which veins and elongated lenses of quartz occur. What is locally known as the main vein of the Mother Lode passes through the full length of the property near the western boundary and is called the Calaveras vein. The vein is really a branching and overlapping belt of parallel veins and stringers of white quartz. Single veins have quartz up to a width of 12 ft. in places, but they are usually narrower. The minable width varies up to 40 ft. as a maximum, but in this case the ore consists mostly of schist. At this vein the country rocks comprise schists that grade from black slaty rocks to light sericite schist, with schistose serpentine on the footwall side.

Ore in the Calaveras vein usually occurs in shoots from 100 to 400 ft. long. Sample records indicate a gold content of $4 per ton for the principal ones. In most of the oreshoots, the gold is in the quartz, but in that now being mined by power-shovel operations the ore is in the schist on the hanging-wall side of the quartz vein. In this orebody the schist contains interlaminated stringers of quartz and calcite. Strike faulting, distributed unevenly through the schist of the vein, makes the ground heavy and causes considerable contortion of the ore.

The Morgan mine and the adjacent Melones mine are situated along the Bull vein, which is a member of the Mother Lode vein system lying east of the Calaveras vein. In the Morgan mine, on Carson Hill, the two veins approach each other and are only about 200 ft. apart. To the south they diverge at an angle of about 35 deg., but farther south they again converge and almost come together at the Stanislaus River. The Bull vein itself is a vein of hard, massive, white quartz, 50 ft. wide in places. For practical purposes the quartz is barren. Samples usually assay about 40c. per ton, though in a few places the quartz will assay $1.50. The dip is to the east at an average angle of 60 deg.

The early mining on Carson Hill was all on the western or footwall side of the Bull vein, principally along a system of small quartz veins known as the pink vein. It was in this area that Fair's mining was done. The large nugget of gold previously referred to was taken from a shallow shaft on this vein. Until 1917, it was generally thought that the principal orebodies were on the footwall side of the Bull vein; although, as a matter of fact, ore had been found before that time by the Melones company on the hanging-wall side, on the 1,100 ft. level and on deeper levels.

In 1917, operations by the Calaveras Consolidated Syndicate, under the direction of W. J. Loring, disclosed high-grade gold ore on the 300-ft. level on the hanging-wall side of the Bull vein. The ore consisted of more or less silicified schist, mineralized principally with pyrite, but containing also a little galena and occasional spots of chalcopyrite. Channel samples assayed as high as $80. Stopes on the ore were as wide as 30 ft. By 1926 this oreshoot had been mined continuously down to the 4,550-ft. level. The average grade of this "hanging-wall oreshoot" was $12.66 per ton.

Of especial interest today are the bodies of low-grade ore, of around $2 and $3 value, that are found throughout the mine from the surface downward. This ore consists almost entirely of mineralized schist. It occurs in widths up to 50 ft., and even 100 ft. in one place. These orebodies are found both on the hanging-wall and on the footwall side of the Bull vein, and their development and exploitation are now under way.

In addition to the orebodies previously

described a series of "flat veins," lying on the hanging-wall side of the Bull ledge fissure, have been developed at Carson Hill. The hornblende andesite, an intrusive body of partly metamorphosed rock, where it lies close to the Bull vein, is sliced by a series of parallel fault fissures that dip easterly at angles of 30 deg., and the fissures have been mineralized. At least five of these fissures occur. According to a geological report by Malcolm Maclaren, "they were formed by compressive forces and are therefore thrust or reverse faults. They are later in origin than the Bull ledge, which they actually fault in the case of the 1,100 flat vein. In other cases they merely bend the Bull ledge to a greater or lesser extent, dependent on their strength. They are developed as lodes only in the hard, blocky hornblende-andesite that lies on the hanging wall of the Bull ledge channel." It should be noted, however, that the flat veins also make ore in the sericite schist.

The flat-vein orebodies are important. The 1,100 flat vein has been stoped in large quantity, and ore is now being mined in it. Widths of 30 or 40 ft. are common. The core of the orebody is a quartz vein, usually 2 or 3 ft. thick, but the great widths of ore are mostly of country rock, usually sericitized, mineralized with pyrite, and containing gold. Where this orebody meets the Bull vein, an enlargement takes place that has not yet been fully explored, but it is known to be over 50 ft. wide.

Fungus and rust are the enemies of an idle mine. At the time of the shutdown in 1926, the mine and the mill were in good operating condition. In 1933, the mine was hardly accessible. Everywhere, with one notable exception, dry rot had weakened the timbers at stopes, raises, and shafts, and had let down stope fills and caved rock in sufficient quantity to close most of the openings, though in general the ground and the drifts do not require timbering. The exception noted was in the old Melones shaft from the 1,100-ft. haulage level to the 3,000-ft. level. The shaft had been timbered with Port Orford cedar more than twenty years ago. These timbers are still sound and strong, in contrast to the adjacent pine timbering of the level stations, which were rotten and had fallen by their own weight.

In the stamp mill, the main structural timbers were sound, but the footings of the battery posts, the frames and decks of the concentrating tables, the launders, and miscellaneous woodwork were damaged and had to be replaced.

The worst damage was at the cyanide plant. There the vats had been kept full of water and most of them were in fair condition, but the sills and substructures of three 40-ft. vats had to be entirely replaced. The trusses over nine sand tanks and thickeners were rebuilt, and many of the pine structural timbers and launders that were exposed to the weather were renewed. All piping was replaced. The 18-ft. Oliver filter was entirely rebuilt, with new woodwork, pipes, and valve. The old system of zinc-box precipitation was discarded and replaced by zinc-dust precipitation in canvas bags.

Repairs and alterations to mine and mill cost about $100,000.

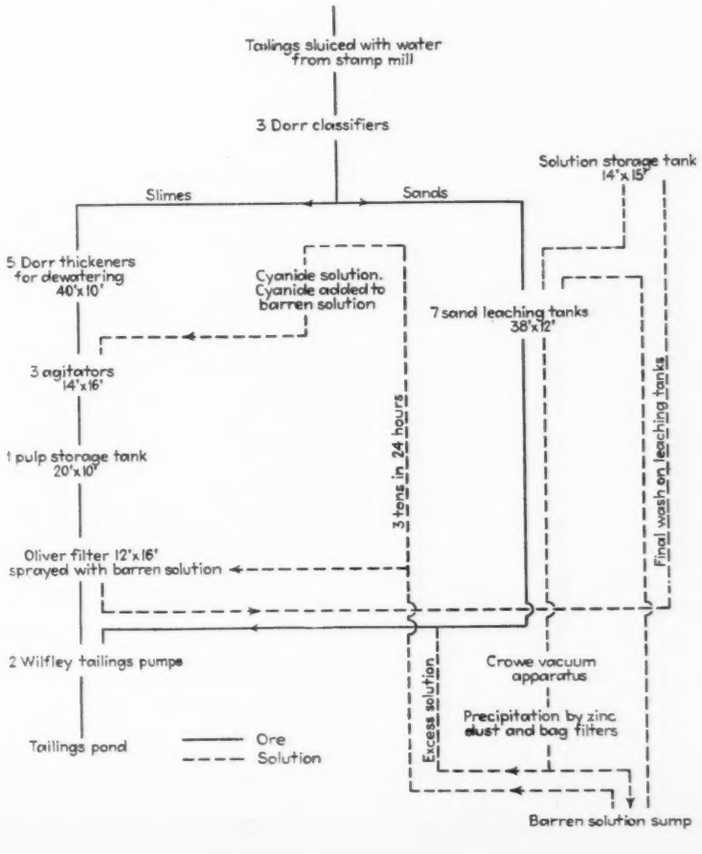
The main haulage adit, through which ore is delivered to the mill, extends northerly for one mile, from the surface plant at Melones to a point under Carson Hill, 1,100 ft. below the surface. An electric trolley locomotive and seven 8-ton cars are used to haul the ore. The track is of 3-ft. gage; and 60-lb. rails are used. From the haulage level, the Morgan shaft extends upward 800 ft. to the 300 level adit, and the Melones shaft extends down to the 3,000-ft. level. The Morgan shaft is used only for hoisting men and supplies. All ore from above the 1,100-ft. level is dropped down to that level through ore passes, from which it is loaded into the haulage cars.

The Melones shaft has three compartments and is sunk on the footwall side of the Bull vein to the 3,000-ft. level, at an inclination of 50 deg. Levels are spaced at irregular intervals, varying from 150 to 250 ft. All ore from levels below the 1,100 is hoisted in 3-ton skips through this shaft to a 1,000-ton storage bin above the haulage level. The Melones shaft was not sunk below the 3,000-ft. level, because the hanging-wall orebody was getting farther and farther away from the shaft as it got deeper. For this reason a new shaft or winze was sunk on the orebody from the 3,000-ft. level, at a point 250 ft. south of the Melones shaft. This shaft was extended to the 4,550-ft. level under former operations, and the present bottom of the mine is at that depth. Ore of commercial value occurred to the bottom. At present no work is being done below the 1,600-ft. level.

Since the shutdown in 1926, the mine has filled with water to the 2,500-ft. level. The water is mostly drainage from upper levels. No unwatering has been done since operations were resumed.

The purpose of the present operating company is to work the low-grade ore at a profit, though not to neglect any opportunity of finding new bodies of high-grade ore. By "low-grade" ore is meant that which assays from $2 up (gold at $20.67), though ore of lower grade than $2 can be worked profitably if so situated that it can be cheaply mined. To accomplish this purpose the tonnage milled must be kept as large as possible and expenses must be kept down. Ore of this grade can be mined

Fig. 2—Generalized flowsheet of Carson Hill cyanide plant. The solid lines represent the flow of ore; the broken lines that of the solution



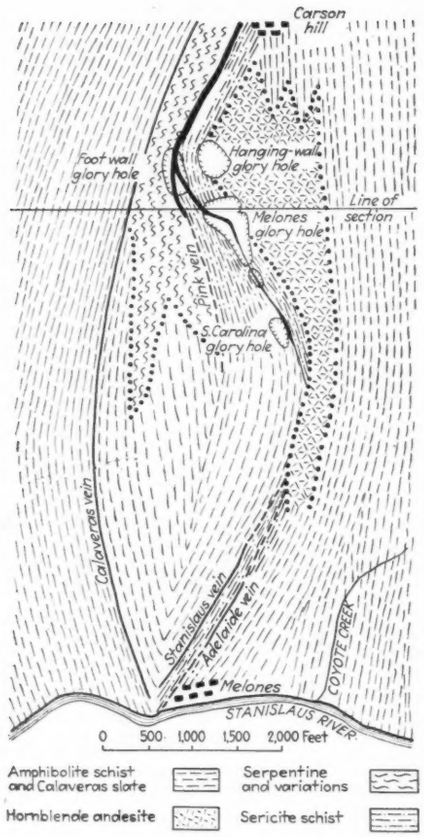


Fig. 3 — Diagrammatic plan, after Malcolm Maclaren, showing contact relations of the quartz veins and the rock formations

only where the cost of mining can be kept low, and the least expensive mining methods must be chosen compatible with safety. Overhead expenses must be kept to a minimum and fancy frills and stunts eliminated. At the same time, a policy of this kind need not be niggardly, and should be liberal as regards the acquisition of efficient, labor-saving machinery. The plan is much like that of certain well-managed farms that I have seen, where the owner's house is of modest size, but his stock barns and machinery sheds are roomy and well kept. Here, we want a modest office and big stopes.

Some of the stopes are big. The footwall glory hole is producing 6,000 tons per month with four miners working. The ore is drawn through millholes to a grizzly on the 200-ft. level and is passed from there to a loading chute on the 300-ft. level. From this chute it is transferred in man-operated 2-ton cars, 100 ft. to the main orepass, through which it passes by gravity 800 ft. to the loading chutes on the 1,100 haulage level. On the 675-ft. level, preparations are being made to stope an orebody, 50 ft. wide, by the shrinkage method. The ore consists of mineralized schist on the hanging-wall side of the Bull vein and extends downward to the 1,100-ft. level. The projected plan for mining it is to take it in stopes 50 ft. long, leaving pillars between and shooting the pillars out when the stopes are completed. Drilling and blasting will be done from a raise driven in the middle of the stope, so that miners need not work under overhanging ground. The ore will be drawn through special grizzly chutes fitted for blockholing. The plan may be modified as the work proceeds. In other places, shrinkage stopes are being worked in the usual way by overhead drilling. The Leyner type of drills are used almost exclusively.

In the flat veins the ore is broken in open stopes to widths up to 40 ft. with pillars left for support, and the broken rock is moved to ore passes or loading chutes by mechanical scrapers, or by tram cars in some places.

At the outcrop of the Calaveras vein a body of ore 20 to 40 ft. wide and 400 ft. long is being loaded into trucks by a power shovel and hauled three-fourths of a mile to a loading chute of 150 tons' capacity, where it is picked up by the electric train and hauled to the mill. The ore is broken by blasting in benches 19 ft. high. Holes are drilled 19 ft. deep with a mounted machine drill. Black powder, or 40 per cent dynamite, is used in the form of "bag powder." Electric detonators are employed. Similar work is planned for other outcropping oreshoots.

Production of ore is limited by the mill capacity. At present the tonnage treated is about 20,000 per month.

The mill is the one used by the former operating company, remodeled in some respects, and the procedure is: crushing in two Sturtevant 12x26-in. jaw crushers, followed by further crushing through half-inch screens by thirty 1,250-lb. stamps, and grinding in open flow by 8 ft. x 36 in. Hardinge pebble mills. The largest particles of ore discharged from the Hardinge mill are about 0.10 in. in diameter. Although this seems to be coarse grinding, assays of this material show value too low to warrant finer grinding. Amalgamation begins at the discharge of the Hardinge mills, where cylindrical amalgamating plates are inserted in the discharge end of the mill. This is followed by plate amalgamation of the usual type. Traps to catch coarse gold are inserted below the mortar lips, and at the head of, and between, the amalgamation plates. From the plates the pulp passes over Deister roughing tables and Deister Plat-O concentrating tables. Table tailing flows through a flume to the cyanide plant. Concentrate is reground in pebble mills, passed over two types of amalgamators and then over a Wilfley finishing table operated by a "Vari-drive" motor. A small cut from the upper edge of the Wilfley concentrate containing fine gold is saved in cans and is "barreled" with quicksilver at convenient intervals. The entire mass of concentrate, after this treatment, is turned back into the tailing stream from the stamp mill and is passed on to the cyanide plant for further treatment.

Half of the gold is recovered in the stamp mill. When the Wilfley table was set up, it was thought that a small quantity of minerals, such as tellurides, rich in gold but difficult to treat in the cyanide plant, would be recovered in the small cut from the table, and it was planned to ship it to a smelter; but tests run on the concentrate showed that a good recovery was made by cyaniding. Concentrate from the small cut assays in the hundreds of dollars. The average concentrate, before regrinding, assays $30 to $40 per ton, of which about $10 to $20 is recovered in the stamp mill before cyaniding. A flow sheet of the stamp mill is shown in Fig. 1.

The cyanide plant is the one that was formerly operated by the Melones company and later by the Carson Hill Gold Mines, Inc. It was rebuilt and put in first-class condition by the present company, with some important changes. A flow sheet is shown in Fig. 2. Tailing from the stamp mill is classified into sands and slimes and the two are treated separately. The principal

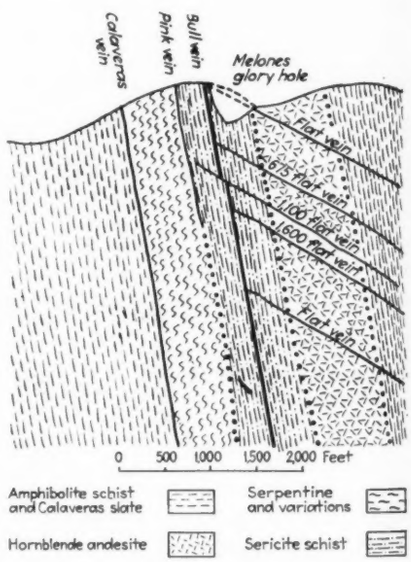


Fig. 4 — Diagrammatic cross-section, after Malcolm Maclaren, showing the veins on the property of the Carson Hill Gold Mining Corporation

change was in the method of precipitation. The former zinc-box treatment was changed to precipitation by zinc dust and filtration in canvas bags. Cyanide solutions are maintained at a strength of 0.4 lb. of cyanide per ton of solution. Tailings carry about 23c. in gold per ton. The entire cost of stamp milling and cyaniding is about 56c. per ton of ore. A recovery of 88 per cent is made on the entire operation. During previous operations, when the plant was operating on higher-grade ore, the recovery was 92 per cent. It is thought that the lower recovery of today is a feature of cyaniding ore of such

low grade; that the undissolved gold in the cyanide tailing will remain fairly constant, even with an increase of $1 or $2 in the grade of the ore. In this way the percentage of recovery would increase with higher head values.

The milling and cyaniding plant is operated by the company, with the firm of Hamilton, Beauchamp & Woodworth as consulting metallurgical engineers.

All figures in the foregoing, relating to the value of gold, are at the old price of $20.67. All records, except sales records, are kept on this basis.

The cost of operation in this early stage of operations is still in a state of flux; and cost data given today might not be representative a few months later. At the present milling capacity of about 665 tons per day, the cost of mining, milling, and overhead costs, including taxes and a proportionate charge for newly purchased machinery, is about $2 per ton. The apparent anomaly of working ore of $2 gross value at a profit, when costs are $2 per ton, is explained of course by pointing out again that the figure of gross value is stated by figuring gold at $20.67 per ounce; whereas it is sold now at $35 per ounce.

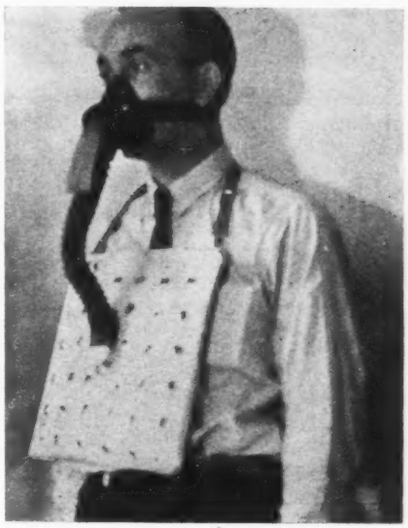
Shortly before he died in 1853, Jim Carson sent a message of cheer to his *compadres* at Carson Hill: "It is to you, diggers, I speak—you who are enduring the hardships of the mountains, and working hard to honestly gain a fortune. Many of you, no doubt, are not making much more than what supports you comfortably, but a majority of you are getting more money per day for your labor than you could per week at any place in the civilized world; and you are happy, independent, and your own masters. A great many are realizing fortunes in a short time. Don't any of you despair; there are yet just as rich diggings as ever have been discovered, and as large 'chunks' beneath the earth yet as have ever been taken therefrom. It is true you have to work harder now to get it than formerly, yet it is to be had . . . Never give up nor think that the days of making fortunes in the gold mines have passed. Thousands will be making fortunes in the California a hundred years hence."

We gold diggers of today, successors in fact to Jim Carson and his hardy pioneers of '49, may well take the message to ourselves and pass it on to those who take up where we leave off. In spite of our "modern methods," our electric power, our mechanical shovels, our pneumatic drills, and our cyanide plants, we too will be looked back upon, many years hence, as old-timers, perhaps as a sort of secondary pioneers. There will still be gold when we are through. Without doubt, the man of a far tomorrow, with newer methods and different economic conditions, will still dig for gold, and, we hope, will still be happy, independent, and his own master.

The Hollinger Respirator

W. A. Jones and *D. A. Macleod*

Engineering Staff, Hollinger Consolidated Gold Mines, Ltd., Timmins, Ontario, Canada



The Hollinger respirator offers so little resistance to breathing that men wearing it may readily walk about or do a moderate amount of work

MINERS at the property of Hollinger Consolidated Gold Mines, Ltd., Timmins, Ontario, Canada, are using, under certain dusty working conditions, a new respirator designed by the technical staff of the company. The description of the device that follows is presented through the courtesy of the Hollinger management.

Conditions under which the new respirator is employed occur in the daily blasting of complete rounds in development faces. After the "cut" holes of such a round are fired, air and water are blown at the face for a period of fifteen minutes. At the end of this time, the dust content of the air within about 30 ft. of the face is generally reduced to about 500 particles less than 5 microns in diameter per cubic centimeter of air. From 30 to 200 ft. from the face, the air contains several thousand particles of dust per cubic centimeter. A large number of tests, performed under actual working conditions, indicate that men wearing the Hollinger respirator are protected from dust when they return to the face to load the "square-up" holes of the round.

The method of testing respirators followed at the Hollinger mine is to take konimeter samples of the air through a short tube inserted in the face piece while the wearer is inhaling in the densest concentration of dust in which the mask will be used. The object of such a test is to determine the number of particles of harmful size present in a cubic centimeter of the air that penetrates the filter and enters the nose and mouth. Obviously, if the face piece is poorly fitting or is displaced during the sampling, high dust counts will result, but when care is exercised a number of respirators may be tested in succession without leaving the dusty atmosphere. Results of sampling vary according to the efficiency of the filter and the rate of inhalation.

When the experimental work was commenced reference was made to the literature on the efficiency of various fabrics against dust particles 1 to 5 microns in diameter. The materials that gave the best results in laboratory tests made elsewhere were used in respirators constructed for practical trials in concentrations of 1,000 to 1,300 particles of dust less than 5 microns in diameter per cubic centimeter of air. The results were disappointing in that low efficiencies were obtained when respirators were designed from published data. Since leakage around the face piece or through the exhalation valve did not appear to be a serious factor in the results, the conclusion was reached that much larger and denser filters would have to be used than laboratory tests made elsewhere indicated.

The filter finally adopted consists of a flat bag, 10.5 in. by 11 in. by 1 in., the sides of which are made of two layers of medicinal absorbent cotton between three layers of thin pennant felt. A spacer of 8-mesh enameled steel-wire screen, with a regular pattern of hemispherical indentations, prevents the bag from collapsing. The filter, which is protected by a canvas cover perforated with ⅜-in. holes fitted with metal eyelets, is connected to the face piece through a light, flexible, corrugated rubber tube. Large, efficient inhalation and exhalation valves are provided in the face piece to minimize the resistance to breathing and prevent the accumulation of heat and moisture. When the mask is worn in the highest concentrations of dust to which men are exposed, konimeter samples taken inside the face piece, while the wearer is inhaling, do not contain more than 300 particles less than 5 microns in diameter per cubic centimeter of air. The resistance to breathing offered by the filter and valves is low, so that men wearing the mask may readily walk about or perform a moderate amount of work, such as loading the "square-up" holes of a round, without discomfort.

More Facts on the Flotation of Free Gold

Research Laboratory Conducts New Tests on a Siliceous Ore

L. H. Lange

Metallurgist,
The General Engineering Company,
Salt Lake City, Utah

DURING the last five years rapid strides have been made in the ore-dressing metallurgy of gold ores. Theretofore, amalgamation and cyanidation were the two chief processes employed in the treatment of precious-metal ores, but with the marked development of flotation and flotation reagents in the last few years, this comparatively new innovation of ore-dressing has become a third and a popular method of treatment in the beneficiation of refractory and non-refractory precious-metal ores. Although the flotation process alone has proved to be an important method, it has its greatest application when used in conjunction with amalgamation, cyanidation, or both. For example, research (and practice) has definitely demonstrated the fact that coarse free gold (plus 48 mesh) is not easily floated, and consequently when this condition exists, amalgamation (or jigs, or gold traps and blankets followed by amalgamation of these products) is the natural procedure to follow for the recovery of coarse gold, followed by flotation to recover the fine gold that may be free or locked in the sulphide content of the ore. Again, the gold in an ore may be finely associated with sulphide minerals, preventing recovery by amalgamation (for example, a pyritic gold ore), but with the use of flotation a concentrate may be produced that can either be shipped to the smelter, or treated by cyanidation, resulting in a satisfactory recovery of the values, thus eliminating the higher cost of a cyanide plant for the total mill tonnage, and also the cost of smelting charges and similar items. Many other examples, such as flotation of cyanide tailings, can be given, showing the various combinations of the three processes mentioned in the foregoing, that are being used today in mills throughout the world, but the cases cited serve to point out briefly the application of flotation in the present-day metallurgy of gold ores.

Wanted: a Shortcut

The fact that flotation has become such a popular method of treatment for gold ores has stimulated research by many private and governmental metallurgists. If it were possible to tabulate and properly correlate all the data that have been compiled from the vast amount of work completed to date on this problem, a workable theory might be formulated that would prove not only a valuable shortcut to the solutions of problems not satisfactorily solved today, and problems that come up daily, but also would serve to help further in throwing light on the hazy questions concerning the "fundamentals of flotation."

Certain flotation reagents and flotation circuit conditions have proved successful in the treatment of many ores. Nevertheless, every ore still presents a problem in itself, a proper method of treatment being arrived at only through a series of "cut-and-try" tests. As long as this condition exists, a vast field remains open for further research investigations. No one knows how long it will be before an empirical formula will be developed that will serve as a "cure-all" for every problem. But, even at the present writing, the large amount of published information on the subject aids appreciably to reduce the number of "cuts and tries" for the solution of any problem in question. This fact plainly shows the need of further enlightenment and additional research to aid the metallurgist to combat future problems.

In recent months, a considerable amount of technical literature has been published on the flotation of free gold, with discussions pertaining to results obtained with various collectors and pulp-conditioning reagents. For instance, Leaver and Woolf set forth, in a Bureau of Mines publication (R.I. 3226—March, 1934, Gold Recovery Studies) and in a paper presented before the Electrochemical Society, entitled "Factors Affecting the Flotation of Gold in Milling Ores," the following general conclusions:

1. Clean metallic gold, minus 60 mesh in size, can be floated successfully from a siliceous gangue containing pyrite with the usual flotation reagents used for sulphide ores.
2. Gold does not float as readily or as rapidly as most of the mineral sulphides.
3. Reagent No. 208 is a very effective promoter tried in this work.
4. Copper sulphate does not increase the recovery, but increases the rate of flotation.
5. Gold coarser than 40 mesh is not recovered in the usual flotation concentrate.
6. CaO is a depressant for gold during flotation.
7. Sodium sulphide in general retards the flotation of free gold.

In observing the circuit conditions employed in mills in various mining districts, these conclusions seem warranted, with a possible exception regarding collecting reagents. In this latter phase a wide variance and selection are employed, depending chiefly on the character of ores being treated, and also possible prejudices. Sulphidizing agents are being used successfully . . . their success being due quite likely to the explanation offered by Leaver and Woolf that the sulphidizer (most commonly sodium sulphide) may aid in the dispersion of the slime in the ore and this aid may counterbalance its retarding effect.

Table I — Gold Recoveries Using a Collector (or Collectors) and Pine Oil

Test No.	Lb./Ton Collector	Collectors	Recovery, % of Au
1 and 30	0.1	Pentasol xanthate	84.51-84.12
5	0.1—0.1	Pentasol xanthate—Thiocarbanilide	86.62
9	0.1	Amyl xanthate	84.00
10	0.1	Minerec B	78.88
16	0.1	Aerofloat No. 31	84.88
24	0.1	American Cyanamid No. 301	59.94
25	0.1	American Cyanamid No. 208	71.80
26	0.1—0.1	American Cyanamid No. 208 and No. 301	74.92
27	0.1	American Cyanamid No. 404 (2 lb. ammonium phosphate to ball mill)	64.91
28	0.1	Ethyl xanthate	57.71
29	0.5—0.1	Water-gas tar — ethyl xanthate	73.44

A New Series of Tests

To obtain further information and data on the subject of the flotation of free gold, and also further to verify, if possible, foregone conclusions pertaining thereto, a series of flotation tests were run on a siliceous free gold ore containing a very small percentage of sulphides (less than 1 per cent) with the gold free to the extent that approximately 80 per cent was recoverable by amalgamation at 55 per cent minus 200 mesh grinding. The heads of

this ore averaged approximately 0.55 oz. gold per ton.

This investigation was carried out with the following objectives:

1. To determine the effect of lime, soda ash, and sulphuric acid circuits on the flotation of free gold.

2. To determine the effect of sodium sulphide (sulphidizing agent), copper sulphate (activating reagent), and solium silicate (dispersing reagent) on the flotation of free gold.

3. To determine the potency of various collectors on the flotation of free gold.

4. To determine the effect of high and low pulp densities on the flotation of free gold.

OBJECTIVES OF THE TESTS	RESULTS OF THE TESTS
1 To determine the effect of lime, soda ash, and sulphuric acid circuits.	**1 Lime and soda ash produce a depressing effect. Sulphuric acid aids at 4-to-1 pulp density, but acts as a marked depressant at higher densities.**
2 To determine the effect of sodium sulphide (sulphidizing), copper sulphate (activating) and sodium silicate (dispersing).	**2 Sodium sulphide acts as a depressant. Copper sulphate, used with only a collector and a frother, has little apparent effect. Sodium silicate has a slightly depressing effect.**
3 To determine the potency of various collectors.	**3 Pentasol and amyl xanthates, Aerofloat No. 31, and a combination of Pentasol xanthate and thiocarbanilide gave the best results as collectors.**
4 To determine the effect of high and low pulp densities.	**4 Circuits of high pulp density—namely, 2.5 to 1—are best.**

The crude ore was crushed through rolls to pass 14 mesh. Representative portions of this material weighing 1,000 grams each (with the exception of test No. 14, in which 500 grams were employed, and tests 12, 13, 15, 21, in which 1,500 gram charges were used) were ground in a laboratory ball mill to 6 per cent plus 65 mesh, 55 per cent minus 200 mesh, with or without reagents, agitated 5 min. with reagents and floated in a standard 1,000-gram laboratory flotation machine of the Sub-A type, the flotation period lasting for 10 min. The pH of the tailing water from each test was recorded. The concentrates and tailings were dried and assayed, the recoveries being calculated from the calculated heads derived from the concentrate and tailing assays. Due to the large amount of free gold in the ore, both coarse and fine, the heads varied from a low of 0.333 to a high of 0.905 oz. gold, with an average of approximately 0.55 oz. Tabulated results of this investigation are found in the accompanying Table II.

Previous to this investigation, our experience in regard to the flotation of metallic gold has been that the simple reagent combination of Pentasol xanthate and steam-distilled pine oil usually gave the optimum results. With this criterion, a test was run (test No. 1) using 0.1 lb. Pentasol xanthate and 0.1 lb. S. D. pine oil per ton of ore (4 to 1 density for flotation) to obtain a recovery level on which to base comparisons in further tests. An 84.51 per cent recovery was obtained. For this ore a flowsheet was designed, using blanket concentration and amalgamation, recovering approximately 80 per cent of the gold, followed by flotation of the amalgamation tailings, with an ultimate total recovery of 94 per cent. The 84.51 per cent recovery, as pointed out in the foregoing, although not as high as obtained in tests that will be discussed later in this report, may be considered fairly satisfactory, particularly so for comparison with other reagents and pulp conditions studied.

Effect of CaO Circuits—Employing the conditions of test No. 1 with the addition of 0.5 and 3.0 lb. lime per ton, respectively, for tests 2 and 3, we found that this alkaline reagent, with Pentasol xanthate as the only collector present, has a marked depressing effect on the flotation of the gold, recoveries being lowered from 84.5 to 73.6 per cent and 67.21 per cent. When using thiocarbanilide as the collector, addition of ½ lb. CaO per ton of ore lowered the recovery to 64.88 per cent (Test 6). The outcome of this phase of the investigation thus serves to corroborate results obtained by other investigators; namely, that lime acts as a depressant for gold in a flotation circuit.

Soda Ash—The combination of thiocarbanilide and Pentasol xanthate as collectors gave a recovery of 86.62 per cent of the gold (test No. 5). When soda ash was employed with these two collectors (test No. 8) the recovery of the gold was lowered to 66.07 per cent, a result plainly showing the depressing effect of this alkaline reagent in the flotation of free gold. Test No. 31 gives

Table II—Results Obtained in Floating a Siliceous Gold Ore

	Five-Minute Conditioning		Ten-Minute Floating Period							
Test No.	Reagents to Ball Mill; Lb. per Ton of Ore	Reagents to Conditioner; Lb. per Ton of Ore	Grind, %—200	pH Tailing Water	Density Flotation	Assay Conc's	Assay Tailings	Calc. Heads	% Recov. Conc's	% Loss, Tailing
1	None	0.1 Pentasol xanthate, 0.1 pine oil	55	8.3	4:1	6.87	0.08	0.485	84.51	15.49
2	0.5 CaO	0.1 Pentasol xanthate, 0.1 pine oil	55	8.3	4:1	7.07	0.190	0.669	73.60	26.40
3	3.0 CaO	0.1 Pentasol xanthate, 0.1 pine oil	55	9.4	4:1	13.92	0.280	0.820	67.21	32.79
4	0.5 CaO, 0.1 thiocarbanilide	0.1 Pentasol xanthate, 0.1 pine oil	55	8.3	4:1	3.54	0.150	0.489	72.39	27.61
5	0.1 thiocarbanilide	0.1 Pentasol xanthate, 0.1 pine oil	55	8.3	4:1	5.65	0.075	0.517	86.62	13.38
6	0.5 CaO, 0.1 thiocarbanilide	0.1 pine oil	55	8.3	4:1	5.24	0.180	0.482	64.88	35.12
7	0.5 CaO	0.1 Aero No. 31, 0.1 pine oil	55	8.3	4:1	4.11	0.100	0.499	81.98	18.02
8	1.0 Na_2CO_3, 0.1 thiocarbanilide	0.1 Pentasol xanthate, 0.1 pine oil	55	8.4	4:1	4.45	0.225	0.604	66.07	33.93
9	None	0.1 amyl xanthate, 0.1 pine oil	55	8.3	4:1	6.47	0.090	0.525	84.00	16.00
10	None	0.1 Minerec B, 0.1 pine oil	55	8.3	4:1	4.55	0.120	0.517	78.88	21.12
11	None	2.0 H_2SO_4, 0.1 Pentasol xanthate, 0.1 pine oil	55	6.9	4:1	5.12	0.045	0.469	91.22	8.78
12	None	2.0 H_2SO_4, 0.1 Pentasol xanthate, 0.1 pine oil.	57	6.9	2.5:1	8.12	0.360	0.905	63.01	36.99
13	None	2.0 H_2SO_4, 0.1 Pentasol xanthate, 0.1 pine oil.	57	6.7	2.5:1	16.03	0.305	0.775	61.83	38.17
14	None	0.1 Pentasol xanthate, 0.1 pine oil	55	8.0	9:1	4.25	0.085	0.437	82.19	17.81
15	None	0.1 Pentasol xanthate, 0.1 pine oil	57	8.2	2.5:1	6.86	0.060	0.582	90.47	9.53
16	None	0.1 Aero No. 31, 0.1 pine oil	55	8.3	4:1	4.84	0.090	0.539	84.88	15.12
17	0.1 thiocarbanilide	0.1 Pentasol xanthate, 0.1 pine oil	31.2	8.3	4:1	8.58	0.230	0.818	73.86	26.14
18	None	0.1 $CuSO_4$, 0.1 Pentasol xanthate, 0.1 pine oil	55	8.3	4:1	5.46	0.115	0.645	83.93	16.07
19	None	0.5 Na_2S, 0.1 Pentasol xanthate, 0.1 pine oil.	55	8.5	4:1	6.38	0.350	0.862	62.89	37.11
20	None	0.5 Na_2S, 0.1 $CuSO_4$, 0.1 Pentasol xanthate, 0.1 pine oil	55	8.3	4:1	4.32	0.180	0.656	75.72	24.28
21	None	0.2 Pentasol xanthate, 0.1 pine oil	55	8.3	2.5:1	3.09	0.050	0.333	86.36	16.64
22	0.5 Na_2SiO_3, 1.0 Na_2CO_3	0.5 Na_2S, 0.1 Pentasol xanthate, 0.1 pine oil	55	8.4	4:1	9.73	0.390	0.808	53.92	46.08
23	0.5 Na_2SiO_3	0.1 Pentasol xanthate, 0.1 pine oil	55	8.4	4:1	9.30	0.110	0.569	81.65	18.35
24	None	0.1 American Cyanamid 301, 0.1 pine oil	55	8.4	4:1	7.72	0.215	0.515	59.94	46.06
25	None	0.1 American Cyanamid 208, 0.1 pine oil	55	8.4	4:1	7.04	0.165	0.552	71.80	28.20
26	None	0.1 301, 0.1 208, 0.1 pine oil	55	8.4	4:1	7.98	0.140	0.530	74.92	25.08
27	2.0 ammonium phosphate	0.1 American Cyanamid 404, 0.1 pine oil	55	8.4	4:1	10.26	0.200	0.550	64.91	35.09
28	None	0.1 ethyl xanthate, 0.1 pine oil	55	8.4	4:1	6.43	0.220	0.497	57.71	42.29
29	0.5 water-gas tar	0.1 ethyl xanthate, 0.1 pine oil	55	8.4	4:1	11.50	0.150	0.545	73.44	26.56
30	None	0.1 Pentasol xanthate 0.1 pine oil	55	8.4	4:1	11.56	0.090	0.544	84.12	15.88
31	1.0 Na_2CO_3, 0.1 amyl xanthate 0.1 Aero 15	None	55	8.4	4:1	11.28	0.255	0.432	42.00	58.00

Note: Assays in ounces of gold. Calculated heads derived from concentrate and tailing assays and weights.

further evidence to warrant this conclusion.

Acid Circuit—At a flotation density of 4 to 1, 2 lb. of sulphuric acid per ton of ore (test No. 11), using Pentasol xanthate and pine oil, raised the recovery from 84.51 to 91.22 per cent. The tailing water from this circuit had a pH of 6.9, but at a flotation density of 2.5 to 1 (tests 12 and 13), using the same reagent conditions as already noted, the recovery was lowered to 63.01 and 61.83 per cent respectively for the two check tests. The tailing waters from these latter two tests had a pH of 6.9 and 6.7. To give a correct explanation for these confusing results is rather difficult, but the following theory may apply to the question at hand:

During the five-minute conditioning with the acid, a very faint odor of hydrogen sulphide gas was detected. It is known in connection with the flotation of sulphides that free H_2S gas is a detriment to flotation. In test No. 11, using a 4 to 1 density for flotation, the concentration of this gas would be appreciably less than when using a flotation density of 2.5 to 1, a condition that might possibly account for the decreased recoveries. Thus, in using an acid circuit in connection with the flotation of a free gold ore containing sulphide minerals, the results of this investigation seem to necessitate a flotation density of not less than 4 to 1, and with this condition—an acid circuit apparently aids in the flotation of the free metal.

Effect of Sodium Sulphide (Sulphidizing Agent)—In test No. 19 the same conditions were used as in test No. 1, except for the addition of ½ lb. of sodium sulphide per ton of ore. The recovery of the gold was lowered from 84.51 to 62.89 per cent, a result plainly showing the depressing effect of this reagent on the flotation of the free gold.

Effect of Copper Sulphate (Activating Reagent)—In test No. 18, copper sulphate was used and seemed to have little effect, the recovery being practically the same when used with Pentasol xanthate and pine oil as in test No. 1. The activating effect of this reagent is better evidenced by test No. 20, when used with sodium sulphide. The recovery was raised from 62.89 per cent when sodium sulphide was used alone, to 75.72 per cent when copper sulphate was added.

Effect of Sodium Silicate (Dispersing Reagent)—Sodium silicate in combination with Pentasol xanthate and pine oil (test No. 23) seemed to have a slight depressing action on the flotation of the gold. In test No. 22, sodium silicate, sodium sulphide and soda ash were employed, using Pentasol xanthate as the collector and pine oil as the frother. The combination of these three conditioning reagents that heretofore had shown depressing characteristics produced further depression, bringing about a recovery of 53.92 per cent of gold.

The following collectors were studied: Pentasol xanthate, thiocarbanilide, amyl xanthate, Aerofloat No. 31, Minerec B, American Cyanamid No. 208, American Cyanamid No. 301, American Cyanamid No. 404, ethyl xanthate, and water-gas tar. The results showing recoveries are summarized in Table I.

Under conditions employing just a collector and frother, Pentasol xanthate, amyl xanthate, and Aerofloat No. 31 produce the highest recoveries. The collecting power of Aerofloat No. 31 is apparently only slightly affected by the use of CaO (½ lb. per ton of ore), as shown in test No. 7 (see Table II).

A pulp density of 9 to 1 was employed in test No. 14, using Pentasol xanthate and pine oil as the only reagents. Recovery of the gold was lowered slightly from 84.51 to 82.19 per cent. In tests Nos. 15 and 21, with the same reagent conditions as in the foregoing, a flotation density of 2.5 to 1 raised the recovery from 84.51 to 90.47 and 86.36 per cent. In these two tests the heads varied considerably, but the tailings were practically the same (0.06 and 0.05), thus accounting for the difference in recovery, but showing the advantage obtained by using a higher pulp density for flotation.

Conclusions

Results of this investigation may be summarized as follows:

1. Lime and soda ash produce a depressing effect on the flotation of free gold.

2. A sulphuric acid circuit, when employed at 4 to 1 flotation density on an ore containing a small amount of sulphides, aids in the flotation of the free gold, but in pulps of higher densities, a marked depressing effect results, due possibly to the presence of free hydrogen sulphide gas.

3. Sodium sulphide acts as a depressant in the flotation of free gold.

4. Copper sulphate, when used with only a collector and a frother, seems to have little effect on the flotation of free gold.

5. Sodium silicate has a slight depressing effect on the flotation of free gold.

6. Pentasol xanthate, amyl xanthate, Aerofloat No. 31, and a combination of Pentasol xanthate and thiocarbanilide were the collectors that produced the best results on the free gold ore used in this investigation.

7. The flotation of free gold is best brought about in circuits of high pulp density; namely, 2.5 to 1.

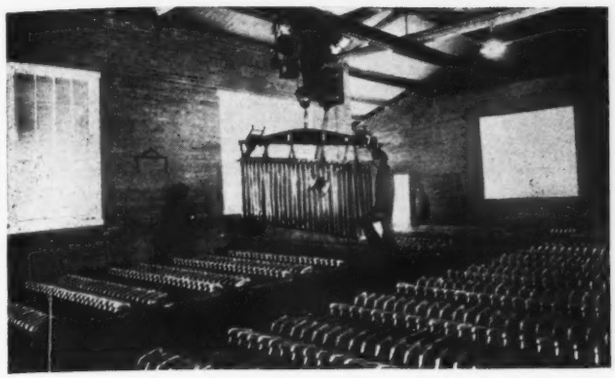
If an investigation similar to the one outlined in this article, but considerably more detailed, involving microscopic examinations of products and screen analyses with assays, could be carried out on a wide variety of free gold ores, and on ores in which the gold occurs both free and finely included with various sulphide minerals, final definite conclusions could undoubtedly be drawn that would simplify, to a great extent, the various problems that confront the metallurgist.

Lake Superior Iron Ore Shipments Came From 121 Mines in 1934

IRON-ORE SHIPMENTS from the Lake Superior Iron Country totaled 22,003,380 tons in 1934, as compared with 21,623,678 tons in the preceding year, according to the report of the Lake Superior Iron Ore Association. In all, 121 mines contributed. Of this tonnage, the mines of the Mesabi range shipped 14,649,131 tons; those of the Marquette range, 2,420,464; those of the Gogebic, 2,286,769; the Menominee, 1,330,753, and the Vermilion and Cuyuna ranges, 785,082 and 531,181 respectively. The Mesabi tonnage came from 55 mines, three of them exceeding the million mark—namely, the Hartley-Burt, with 2,000,942 tons; the Adams-Spruce group, with 1,326,272; and the Sellers, with 1,170,416. The total from this range includes 4,652 tons of magnetic concentrates produced in an experimental mill from tailings of a jigging plant which treats ore from several mines.

The largest individual shipper on the Gogebic range was the Montreal mine, with 582,140 tons; the Ironton following, with 312,710; the Puritan, with 281,973; the Wakefield, with 204,129, and the Newport, with 185,775. On the Menominee, the Chapin, at Iron Mountain, led, with 190,993 tons, the Bristol, Hiawatha, and Bates following in order, with 162,594, 152,598, and 148,078 respectively. On the Cuyuna, the Sagamore shipped 106,766, surpassing the eight other mines. On the Vermilion range, the Pioneer, Sibley, Soudan, and Zenith all contributed, the Pioneer being first, with 430,116 tons. On the Marquette, the Maas, Blueberry, Morris, Cliffs Shaft, Cambria, Volunteer, Tilden, Negaunee, Athens, and Gardner-Mackinaw ranked in the order given, the Maas shipping 331,413 tons and the Gardner-Mackinaw 110,264.

Beneficiated ore included in the total amounted to 5,584,975 tons. Of this 3,440,041 tons was concentrated and the rest crushed and screened or simply screened. The concentrates included 2,656,315 tons "washed," 405,605 jigged, 163,705 sintered, 103,045 "sinter-dried," 106,719 dried, and the magnetic concentrates, experimentally produced and previously mentioned.



A corner of the tank house of Cerro de Pasco's plant at Oroya, Peru, for refining lead bullion by the modified Betts process. Here are the first sixteen cells to be placed in operation. A set of cathodes is being raised from a precipitation tank, to be delivered to the wash tank in the rear.

Casting refined lead at the Betts process refinery, of which only the initial 25-ton unit has as yet been built. The original bullion contains approximately 10 per cent of impurities—principally antimony and bismuth, with lesser amounts of silver, copper, arsenic and tellurium.

Modified Betts Process Yields Refined Lead Bullion

Cerro de Pasco builds first unit of electrolytic plant for this work at La Oroya—Basic changes consist in limiting the corrosion period of the anode and in recovering by countercurrent dip-washing the concentrated fluosilicate solution residual in the pores of the slime blanket

T. E. Harper, Jr.
Director of Research,

Gustave Reinberg
Research Engineer,

Cerro de Pasco Copper Corporation,
La Oroya, Peru

THOUGH the Betts process for refining lead bullion by electrolysis in a fluosilicate bath has been in existence for more than thirty years, it has never been very widely applied in practice, in spite of the peculiar adaptability of lead to electrolytic refining. Apparently, its development has been somewhat neglected because of the generally prevailing impression that it is inherently a high-cost operation; that the lead produced is likely to be of inferior grade, especially with respect to the amounts of silver and copper present; and that the process is ordinarily inapplicable to bullions containing less than 97 to 98 per cent lead without pre-refining. Recent work, indicating that none of these assumptions is necessarily valid, may therefore serve considerably to enhance the status of electrolytic lead refining in the future.

The problem faced by the research department of the Cerro de Pasco Copper Corporation was that of refining bullion with a total impurity content of approximately 10 per cent, consisting chiefly of antimony and bismuth, with lesser amounts of silver, copper, arsenic, and tellurium. It was also desirable to be able at times to treat certain special alloys containing 10 per cent or more of bismuth and as little as 80 per cent of lead, so as to effect an economic recovery of their lead content as well as the byproducts.

Although Betts and others have described the electrolysis of bullions of this nature in a fluosilicate bath, the current densities used were so low as to preclude operation on any considerable scale, and it was generally considered, in the light of accepted knowledge of the Betts process, that its commercial application to highly impure bullion would result in such high acid losses and so low a grade of cathode lead as to be impracticable. A critical study of this subject was therefore undertaken, as a result of which it is now possible to state that bullion of virtually any lead content can be refined electrolytically, at normal current densities (approximately 15 amp. per square foot), with normal acid loss (5 lb. per ton or less), and with the production of lead of exceptional purity[1] (99.99 per cent or better).

The means by which these results are obtained may be made clear by considering the mechanism of the process in the following way: The impurities ordinarily found in lead bullion, being all lower than lead in the electromotive series, remain unattacked at the anode during electrolysis. If present in sufficient amount, such impurities remain attached to the surface of the bullion in the form of a porous mat or blanket, which retains the original physical shape of the anode, the thickness of this porous layer increasing as corrosion proceeds. Inasmuch as the electrolytic current is carried by the solution in the pores of the slime, an ohmic voltage drop occurs across the slime blanket, which also increases in magnitude during the course of the electrolysis. When the value of this voltage drop approximates the solution potential with respect to lead of the most readily soluble impurity present, this impurity will begin to dissolve at the face of the slime blanket (that is, the original surface of the anode), in preference to the continued solution of lead at the back of the blanket. Impurities so dissolved are of course deposited at the cathode, resulting in an electrolytic transfer of impurities through the solution. If the slimes do not remain firmly attached to the anode during the operation, a mechanical transfer of impurities may also occur by floating particles of slime becoming entangled in the cathode deposit, but these are the only two ways in which an impurity present in the anode can reach the cathode. If, therefore, there are sufficient impurities in the bullion to produce a thoroughly adherent slime blanket, and the voltage drop across this blanket can be limited

[1]See U. S. Patent No. 1,915,985.

to a value less than the net solution potential difference available, the purity of the cathode lead will be high and entirely independent of the amount of impurity in the anode.

Because of the fact that the voltage drop in question, at a given current density, is directly proportional to the thickness and inversely proportional to the porosity of the slime blanket, increasing amounts of impurities in the bullion will clearly result in higher voltage drops, other things being equal. One way to limit the voltage drop across the slime blanket under these conditions is to reduce the current density, as has long been recognized. But to maintain the density and reduce the physical thickness of the blanket by changing the anodes oftener is equally efficacious and far more advantageous commercially. That most of the limitations previously ascribed to the process are the consequence of the tacit adoption of a fixed period of anode life, usually of the order of eight days, is now apparent. For with such anodes, if sufficient impurity is present to prevent mechanical transfer, there is usually danger of electrolytic transfer, and vice versa, so that it is often difficult to produce cathodes of really high purity. Moreover, if the total amount of impurities present exceeds 2 or 3 per cent, the electrolytic transfer of impurities, more conveniently referred to as overcorrosion, becomes so heavy as to make the process inoperable at economic current densities.

If the anode life, and hence the maximum thickness attained by the slime blanket, is suitably adjusted to the grade of bullion being treated, these difficulties are avoided. The exact values to be used will of course depend upon the nature of the impurities present as well as other factors, but in general it may be said that no danger of mechanical transfer of impurities will arise with bullions containing less than 95 per cent lead, and that there will be no danger of electrolytic transfer (overcorrosion) with bullions containing more than 90 per cent lead if four-day anodes are used, or with bullions containing more than 80 per cent lead if two-day anodes are used. Under usual conditions of cell constants, electrolyte composition, and current density, the allowable voltage rise across the cell during the electrolysis, which corresponds roughly to the drop across the slime blanket, is from 0.2 to 0.3 of a volt for the types of bullion which have been investigated, but the upper limit in any given case is most easily determined by trial.

The fact that an unusual and a relatively costly acid must be used for the electrolyte makes its conservation a matter of great economic importance to the process. As mentioned in the foregoing, the use of impure anodes has always been associated in past practice with high acid losses, the exact reasons for this relationship not being entirely evident. Probably, if overcorrosion occurs, decomposition of the electrolyte may result from the formation of such compounds as antimony or bismuth fluosilicates, which are readily hydrolyzed. This question is of only academic interest, because overcorrosion must be avoided anyway to secure a pure cathode. When the period of corrosion is suitably limited, at least, any loss of acid by actual decomposition will be so slight as to be negligible. Aside, then, from such purely mechanical and easily preventable losses as those due to leakage or spillage, the attainment of a low acid loss resolves itself into reclaiming as completely as possible the acid carried out of the cells in the pores of the anode slime blanket.

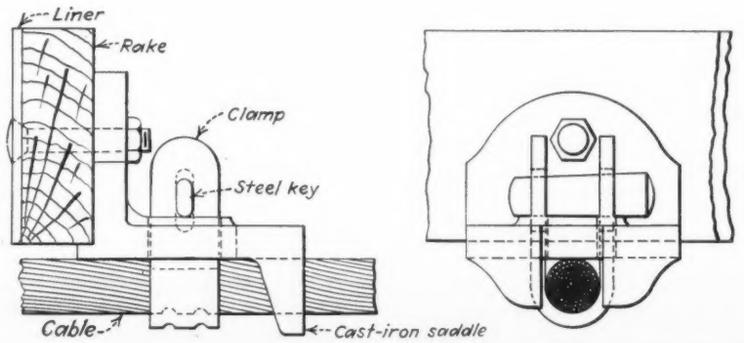
The residual solution in these pores, being formed by anodic action under conditions of restricted circulation, consists of nearly neutral lead fluosilicate of high concentration. With low-grade anodes especially, its strength may be several times that of the main circulating electrolyte. It is therefore a potential source of large acid losses if not carefully handled. Fortunately, the very adherent slimes obtained under these conditions make it easy to apply a simple and efficient method of recovering this acid, which was developed in the course of the present investigation, and is known as countercurrent dip washing. As its name implies, it comprises placing the corroded anodes, with the slimes still attached, into a series of tanks, through which they are advanced progressively at suitable intervals. The strong liquor in the slime pores diffuses rapidly into the successively weaker solutions in the wash tanks until equilibrium is reached. The last tank, from which the washed anodes are removed, is initially filled with water, and the wash solutions advance through the tanks in a direction opposite to that taken by the anodes, being finally returned to the main electrolyte circuit. The concentration thus built in the wash liquor is such that no artificial evaporation is required, and all filter-press work is also eliminated.

With these two basic modifications (dip washing and a limited corrosion period), application of the Betts process to highly impure bullion has become both technically and economically feasible. Of course, the number of anodes to be made and handled is much increased, but this is a small item of cost if proper facilities are provided. The procedure described was originally worked out with laboratory cells, using a current of 7½ amp. on a single anode 6 in. square. A set of four pilot cells, each having five anodes 1 ft. 6 in. wide by 2 ft. deep, and employing a current of 450 amp., was then operated for a considerable time. Finally, two full-size (5,000-amp.) cells were built and operated for a period of about a year, in the course of which all mechanical features incident to commercial refining were carefully checked. The results of the semi-plant scale work throughout having been entirely confirmatory of the original laboratory experiments, the construction of the initial 25-ton unit of a plant to refine lead according to the principles here outlined was undertaken.

This Rake Clamp Boltless

PRIOR to the installation of a boltless rake clamp on the cables of drag classifiers at a certain property, much time was lost when loose clamps had to be readjusted or worn rakes replaced, writes A. T. Lowry, metallurgist, Los Angeles, Calif. The clamps employed were attached to the drag cables by means of angle irons fitted with ⅜-in. U-bolts, which were subject to rapid wear and were a source of trouble. To obviate this difficulty, the clamp shown in the accompanying sketch was evolved. It consists of a cast-iron saddle, a U-shaped clamp, and a steel key.

The removal or an adjustment of the device is a matter of seconds, for only the steel key needs to be removed or tightened. To reduce wear on the saddle to a minimum, the ends that contact with the cogs of the drive sheave should be chilled. The steel keys last from six months to a year.



A·I·M·E

SOME OF THE HIGH SPOTS OF TECHNICAL INTEREST AT THE ANNUAL MEETING

Magnetic Prospecting on the Rand
Fine Grinding and Classification
Reactions in Cyanidation
Cyanidation Practice at Kirkland Lake
Control of Drill Dust
Processing Limestone by Flotation
Some Ore-bearing Fractures
Iron Ore Beneficiation
Gold at Hog Mountain
Aviation in Engineering Geology
A Million Tons of Potash
The Refractories Industries
A Geophysical Atlas
Woolrocks of Illinois

In addition to the abstracts on this page and the following pages, a brief account of the New York gathering on Feb. 18-21 is given on page 142, in the News Section

Magnetic Prospecting On the Rand

PROSPECTING by magnetometer for the southwesterly extension of the Witwatersrand gold field, in South Africa, which was undertaken about four years ago by New Consolidated Gold Fields, Ltd., was the first instance of the application of geophysical prospecting to the investigation of Rand ores, according to Leopold Reinecke. The mined area of the field stretches for 50 miles between Randfontein on the west and Springs on the east, the proved ore-bearing ground being 2 to 7 miles wide, save at the eastern end, where the north-south width is about 18 miles. At each end the strike of the ore-bearing conglomerates, or "reefs," turns south. At the southeastern extremity is the Sub Nigel mine; at the southwestern, the Randfontein. In both of these mining has been conducted for more than 40 years.

Over much of the mined area the Main Reef Series of conglomerates either outcrop or so lie that their position can be easily followed. Beyond the mined area south and southeast of Sub Nigel, the conglomerate outcrops extensively, but, despite much prospecting, has yielded no payable mines. On the other hand, southwest of Randfontein the Main Reef Series is wholly covered save for one small outcrop near the mine. Here, despite the production of 17,000,000 oz. of gold at Randfontein, only one serious attempt at prospecting the country had been made up to the end of 1931. Between 1898 and 1904 a number of boreholes were drilled in an area lying 5 to 17 miles southwest of Randfontein. A series of gold-bearing reefs were intersected and shaft sinking was actually begun, but various adverse factors, including the difficulties experienced at that time in sinking through water-bearing dolomite, contributed to the abandonment of the project. In one large area three boreholes were put down during the same period. Two of them did not penetrate the dolomite cover that overlies the Witwatersrand and the third penetrated into an horizon that lies far below the Main Reef conglomerate in section. For more than twenty years thereafter, no serious attempt was made to discover whether the treasure house of the Rand extended any further than the Randfontein mine.

In 1930, Rudolf Krahmann conceived the idea of mapping with a magnetometric field balance, the sub-outcrop of certain magnetite-bearing shales in the Lower Witwatersrand System of sediments, in areas where these rocks were covered by other formations. He reasoned that if known horizons of such shales could be accurately mapped thus, the position of the Main Reef in covered areas could also be calculated, and so the ground that had to be prospected by drilling could be narrowed in extent. Using a vertical intensity field balance, he proved that a number of the magnetite-bearing beds in the lower 15,000 ft. of the sediments caused anomalies in the earth's magnetic field and that in the case of certain of these beds the anomalies could be detected even when the beds were covered by many hundreds of feet of younger sediments. This demonstration stimulated the New Consolidated into an extensive investigation into the possibilities of discovering the Main Reef horizon in this area.

After preliminary studies near Randfontein, Krahmann went further afield and by a series of reconnaissance traverses, and reasoning from their results, succeeding in establishing the position of the sub-outcrop of the West Rand shale over 23 miles of covered ground, thus narrowing the probable drilling area to a zone south of it. Mineral rights were acquired and detailed magnetometric work was begun to locate borehole sites. Traverses were run southward 1,000 to 2,000 ft. apart, with stations at 50-ft. intervals. Two other anomaly zones higher in the section were also mapped. Borehole sites were selected and drilling was begun. Methods of calculation and results were constantly modified as new knowledge was acquired from drilling. With respect to one old borehole, which was deepened, the sub-outcrop of Main Reef, which at first was calculated to lie 2,940 ft. north of the hole and 5,350 ft. deep (in the hole), is at present believed to be 1,984 ft. north of the hole and 3,613 ft. vertically below the collar. (This with a small limit of error.) Because of many difficulties experienced in drilling, other results are lacking for checking the calculations based on the magnetometric work.

Besides locating the Main Reef sub-outcrop, much useful work was done in tracing dikes and faults by the magnetometer. In all, up to September, 1934, 69,000 field observations had been made and 710 miles of traverse run.

Fine Grinding and Classification

TODAY the trend toward all-slime treatment in cyanidation and flotation has made fine closed-circuit grinding essential, according to a paper by J. V. N. Dorr and Anthony Anable, and the mechanical classifier is now of equal importance with the mill in the preparation of an ore for treatment. Actually, a mill and a classifier are a unit, a variation in either affecting the desired results.

The fact that the grinding efficiency of a ball mill or tube mill increases with the rate of feed has been proved beyond question in the field as well as in the laboratory. The Mines Experimental Station of the University of Minnesota has been particularly active in this work and has published much data that throw light on grinding. Many tests, approximately of plant scale, have been conducted to determine the effect of large oversize returns to the mill. These show that work increases rapidly with the circulating load up to the point where it amounts to five times the new feed. In practice a circulating load of over 18:1 has been used with success.

Proper classification accurately controls the maximum size of the particles in the finished product, whereas high circulating loads and the consequent reduction by stages minimize the formation of superfines.

The multiple-stage grinding flowsheet of today is an evolution of the last 30 years. It seems fairly well established that any given grinding step experiences a loss of efficiency when a greater reduction of diameter than 4 or 5 to 1 is attempted. The first mechanical classifier, the Dorr type, developed in 1904, operated in open circuit on Chilean mill product, dividing it into a slime-free sand for percolation and a sand-free tailing for treatment by agitation.

The next step was the operation of the same classifier in closed circuit with secondary tube mills. With the replacement of stamps by ball mills and rod mills the classifier was again used to close the circuit. Next came the interposition of a bowl classifier between stages, in open circuit and receiving overflow from the primary circuit, discharging a clean sand product to the secondary circuit and overflowing material of finished size to treatment.

Recently some have found it advantageous to add a third stage of classification and grinding, in order that all feed to concentration or extraction treatment may be finished in a single, large bowl classifier in circuit with a mill for regrinding stray oversize and material readily concentrated in the sand product of a bowl classifier. Another recent step is the addition of a preliminary desliming classifier, directly ahead of the primary, closed-circuit grinding unit, after the last stage of crushing. Thus primary slime is removed at the outset.

Though it is true that the mill is the grinder, it is equally true that the classifier controls the system. In the field of metallurgy both theory and practice agree on the desirability of close-circuiting wet-grinding mills with classifiers, because closed-circuit operation increases capacity, reduces unit power cost of grinding, cuts down wear on liners and grinding media, and permits loading of the mill to maximum output of material of the specified size. These advantages have the cumulative effect of reducing the unit cost of grinding, controlling accurately the size of the maximum particle in the finished product and limiting the tendency to overgrind a large part to semi-colloidal size.

With the introduction two years ago of heavier large-capacity classifiers, the deterrent to high circulating loads in commercial milling was removed. Their use has lead to mills with extra large trunnions and feed scoops and to the use of several different schemes for circulating pulp and sand to permit gravity return of the sands to the mill. At least four plants are now holding their circulating loads in 8-10:1, and two have handled loads of 13-14:1. The classifiers used are generally 8, 12, or 16 ft. wide, and there is no mechanical reason why they cannot be made 20 ft. wide, or more.

On the mechanical set-up some basic rules are generally accepted: Rotary mills should be short and of relatively large diameter, with extra large feed and discharge trunnions to accommodate circulating loads of at least ten times the new feed; spiral feed scoops should be of heavy construction, with abrasion-resistant tips and removable liners; loss of grinding media should be checked and adjusted at frequent intervals, wattmeters should serve as guide to correct loading of the mill; the classifier should be large enough and of simple, rugged construction; a constant head tank for dilution water should be available, and dilution of overflow should be checked constantly. Classifiers should, if possible, be so installed that an all-gravity closed circuit is assured.

Reactions in Cyanidation

CYANIDATION of precious-metal ores is a complex chemical process. Numerous reactions occur, some of which cause an undesired consumption of alkali and cyanide. A knowledge of these reactions, their products, and the factors influencing their rate should be of value in working out the most economical conditions in the process. At present much of this knowledge is lacking, according to a paper by G. Barsky, S. J. Swainson and Norman Hedley.

The possibility of any given reaction may be determined by a calculation of the free energy of the reaction; that is, the maximum amount of energy that can be utilized as work, or be transformed into energy other than heat.

In their simplest form the reactions for the dissolution of metallic silver and gold in dilute cyanide are as follows:

$$Au + 2CN^- = Au(CN)_2^- + (^-)$$

(In this and the following equations silver is analogous with gold.)

It has been shown by various investigators that these reactions do not proceed without absorbtion of oxygen or some accompanying reduction reaction. In the presence of oxygen the following reaction is obtained by Elsner:

$$4Au + 8CN^- + O_2 + 2H_2O = 4Au(CN)_2^- + 4OH^-$$

Janin has suggested that gold is dissolved with liberation of hydrogen—

$$2Au + 4CN^- + 2H_2O = 2Au(CN)_2 + 2(OH)^- + H_2$$

And Bodlaender presents a reaction which has the same over-all equation as Elsner's, but which differs in the respect that hydrogen peroxide is formed—

$$2Au + 4CN^- + 2H_2O + O_2 = 2Au(CN)_2^- + 2OH^- + H_2O_2$$

the hydrogen peroxide being used in the following reaction:

$$2Au + 4CN^- + H_2O_2 = 2Au\ (CN)_2^- + 2OH^-$$

As pointed out, the possibility of these reactions can be calculated from the changes in free energy. As the literature contains no data regarding the free energy of formation of $Au(CN)_2^-$ and $Ag(CN)_2^-$, it was necessary to determine these values. This was done by measuring the potential of pure silver and gold in a solution of silver and gold cyanide, containing free cyanide, against a calomel electrode. The NaCN-$NaAu(CN)_2$ solutions were prepared by dissolving pure gold foil in NaCN, the silver solution was prepared by dissolving purified $Ag(CN)_2$ in NaCN. A stream of purified nitrogen was passed through the solution during the measurements. The value for the free

energy of formation of argentocyanide ion was found to be 69,063 cal.; that of the aurocyanide ion 66,382 cal. With these data on the free energies, the equilibrium constants of the various equations given may be calculated. For Elsner's equation the constant for gold is $10^{66.9}$, for silver $10^{58.1}$ These constants show that in the presence of oxygen the reaction will proceed practically to completion; in other words, until practically all cyanide has been consumed, or all metal dissolved. For Janin's equation the corresponding figures are $10^{-9.9}$ and $10^{-13.9}$; these constants are so very unfavorable that the formation of hydrogen may be considered impossible under ordinary cyanidation conditions. For Bodlaender's first reaction the constants are $10^{16.9}$ and $10^{12.1}$; for the second $10^{49.8}$ and $10^{46.0}$, respectively. Here again the equilibrium constants are favorable; thus the reactions proposed are possible.

It is interesting to note that Bodlaender actually found that hydrogen peroxide is formed, and he was able to account for about 70 per cent of the theoretical quantity of this compound that should form according to his equations. In view of this it would appear that these equations express the true reactions that take place when gold and silver dissolve in dilute cyanide. Although Elsner's equation gives the same final products as the sum of Bodlaender's equations, it is not strictly correct, as it does not express the intermediate step involved, the production of hydrogen peroxide, formation of which was proved by Bodlaender.

Elaborate tests were made to determine the rate of dissolution of gold and silver in cyanide. An apparatus was designed for accurate determination of dissolved metal without removing the metal from solution. In these tests the maximum rate of dissolution of pure gold was reached at 0.05 per cent NaCN, which corresponds to concentrations used in modern mill practice. For silver the maximum rate was found for a solution containing 0.10 per cent NaCN.

Cyanidation Practice At Kirkland Lake

DUE to local differences and innovations in general metallurgical practice adopted from time to time, Kirkland Lake has never had a generally accepted uniform scheme of treatment. Lately, according to Donald F. Irvin, there has been a diversion into two types: plants relying solely on cyanidation and those that have added flotation to existing cyanide plants. Much difference of opinion still exists regarding the real value of flotation for the ores in this district; high recoveries are obtained by both methods, and a final comprehensive verdict cannot be given without exhaustive studies of capital cost, operating expenses, net recovery, tailing losses, and ore reserves. Furthermore, there are recognized differences in ore characteristics along the length of the main deposit.

The plants may accordingly be classed in two groups, straight cyanidation, and cyanidation with flotation. Among the first are Toburn, Sylvanite, and Teck-Hughes; the second group includes Wright-Hargreaves, Lake Shore, Macassa, and Kirkland Lake Gold. The latter is now installing a small flotation annex which will be notable in that the concentrate will be shipped directly to a smelter. The flotation plants at Macassa, Lake Shore, and Wright-Hargreaves have tried separate treatment of concentrate, rejecting as tailings the residues from such treatment. They have tried returning these residues to the main flow of pulp for re-treatment. Besides this variation they have used flotation prior to cyanidation of main pulp, as well as floating after the main pulp has been cyanided.

Any consideration of flotation at Kirkland Lake should note the small sulphide content present, 1 to 2 per cent. This causes a meager froth, with much non-sulphidic material. On the whole the flotation equipment is relatively small; Fagergren, Denver, and Kraut cells are among those used.

An interesting change in common practice has been tried at Macassa, where alkalinity of the cyanide solution is in part gained by substitution of ammonia for some of the lime. This is said to have given good results.

The mills all follow generally well-established methods of crushing and grinding. Gyratory crushers and tube mills are standard types. Secondary crushing is done in Symons cones, and regrinding in Marcy, Hardinge, and Allis-Chalmers ball or rod mills. Especially interesting is the use of forged-steel balls made in Canada from discarded rails. Cast balls are also used. Classification is done in Dorr classifiers, of various types and sizes, the largest being recently installed at Wright-Hargreaves and Sylvanite. Agitation is done by various methods. Many Dorr agitators are in use; in several of the later mill turbo-agitators and Wallace agitators are installed. Thickening is mostly in Dorr thickeners, in some cases of the multiple-tray type. Suction thickening in Genters has been used for almost two years at Wright-Hargreaves.

Countercurrent decantation has now been replaced by two-stage filtration, generally preceded by two stages of thickeners. Oliver filters are used in all except two cases where American filters are used. Fine grinding, which now may be 85 per cent to minus 325 mesh, has made filtration somewhat more difficult than for pulps screened 90 to 95 per cent minus-200 mesh. Wilfley sand pumps are generally used for handling slime pulps, although trials with soft-rubber-lined centrifugal slime pumps have been started in some mills.

Control of Drill Dust

EARLY in 1934, the St. Joseph Lead Company bought three Kadco dust-removal units, two suitable for raise work and the other for drifting, according to R. J. Mechin, division manager for the company at Edwards, N. Y. This equipment, resembling large vacuum cleaners, was installed in the company's Balmat mine, in St. Lawrence County, N. Y. In the Kadco system, hoods, through which the drill steel is drawn, control the dust at the drill hole, the dust being conveyed through hose or pipe to a collector, where it is removed from the air stream and the air returned to circulation.

Data on other points having previously been acquired, the company at this time wished only to determine the efficiency of drilling (minutes per foot of hole), when using this dust equipment, in comparison with former practice of drilling dry in a raise and wet in a drift. Comparative dust counts also were taken, however, by the Metropolitan Life Insurance Company when drilling dry, wet, and with the Kadco equipment respectively. These counts (not cited by Mr. Mechin) indicate the following comparative approximations, —expressed in millions of particles per cubic foot of air:

	Raise One Drill	*Drifting Two Drills*
Dry drilling	208.0	266.7
Wet	9.9	14.0
Kadco	1.7	2.86
Exhaust from Kadco collector	2.0	2.0

Results of four months' tests indicate that (1) when using the dust equipment, the number of minutes per foot of raise was 3.899, compared with 5.57 when drilling dry. That is, removal of dust cut the drilling time about 30 per cent. Also, average number of feet drilled per piece of steel dulled when using the dust equipment was 12.16, compared with 7.08 with the dry method. This is thought to be due to better alignment of the steel and the machine when using the dust-control equipment.

This cuts down the amount of binding of the bit in the hole, prolonging the life of the bit gage. (2) Minutes per foot of drift was practically the same when using the Kadco equipment as when drilling wet, being 3.226, compared with 3.106. However, the saving in drill steel was appreciable when using the Kadco equipment, being 15.2 ft. per piece dulled, compared with 7.13 when drilling wet. This greater life of the steel is undoubtedly due to the speedy removal of cuttings from the hole, reducing the grinding action that would otherwise ensue.

Advantages of using Kadco equipment in raising are: (1) The hood extension column used on stopers keeps the machine always in correct position, enabling the driller to change steel quickly. (2) The extension column serves as an important safety device when a steel breaks, as the machine rises only to a certain point where there is an automatic cut-off of the air in the leg used to raise the machine. Also the hood acts as a support in starting the hole, lessening the chance of eye or other personal injury. (3) Gases which are usually present in a raise face after blasting are sucked out of the raise by the suction blower on the collector. (4) Water used in drilling in a raise is not only an annoyance but a definite safety hazard. (5) The increased drilling speed obtained means a saving in compressed air, up to approximately 34 per cent, in operating in raises.

Disadvantages are (1) The extra weight of equipment, and the greater effort required to pull the extra hose up the raise, as compared with dry drilling, in which there is no water hose. (2) Time required to empty the dust collector, which in a small unit must be done twice a shift. These disadvantages are considered offset by the fact that the drillers can stay up in the face as long as desired instead of having to come down out of the dust at intervals.

In drifting, the use of Kadco equipment seems to offer some advantage over wet drilling, though not as much as when a stoper drill is used. Steel consumption is reduced. No water lines are required. Drill lubrication is better. Track laying is done more quickly, the drift bottom being dry. Health hazard is eliminated, and risk of injury to eye or person is lessened. Mine ventilation is improved. The disadvantage is the extra equipment required and its cost.

Processing Limestone By Flotation

MINERAL IMPURITIES of limestone are many and varied. Of major importance are quartz, silicates, magnesium carbonate, iron as oxide, sulphide or carbonate, carbonaceous matter, and calcium phosphate. Both the chemical and the physical characteristics of limestones are important in determining the uses to which they may be put.

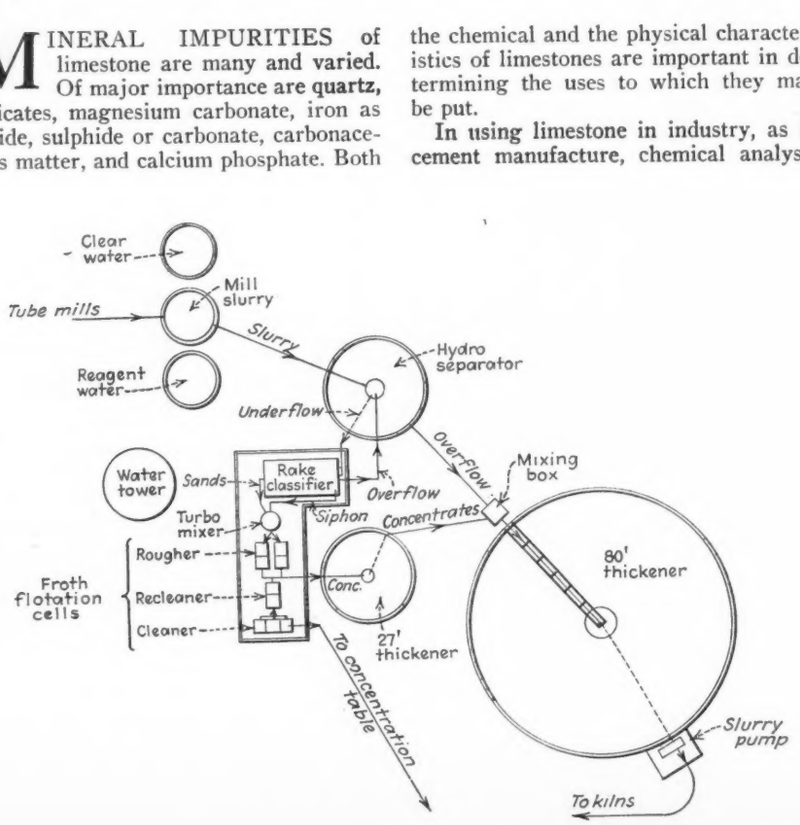
In using limestone in industry, as in cement manufacture, chemical analysis may reveal the necessary elements for making the desired product, but it does not necessarily determine the chemical recombinations that may take place under the temperature and other conditions of the process. The mineral constitution is of greater significance because some minerals readily break up and recombine, whereas others are decomposed only with difficulty. The chief problem has been to control this mineralogical composition.

Another problem has been due to the variable composition of the limestone and of the shales or other substances used. Sometimes a limestone may be of the exact composition wanted. Commonly, however, it must be blended with another stone. Thus it has become important to separate the stones into their mineralogical constituents and then recombine them in proper proportions. Until recently, this seemed impracticable. Froth flotation was tried experimentally by C. H. Breerwood and proved successful. As a result the Valley Forge Cement Company, West Conshohocken, Pa., put a flotation plant in operation in March, 1934, to treat its micaceous stone.

The Valley Forge property contains a large amount of stone that has sufficient lime for making portland cement without adding any other stone. In addition, there is an enormous amount of stone that is too low in lime. It is the latter that is treated by flotation. The flowsheet is shown and suffices for description. Wet grinding precedes. The uniformity of the product is well indicated by the daily results for May, 1934, during which the composition of the product of the final thickener varied only from 73.7 per cent $CaCO_3$ to 77.6 per cent.

Experiments in flotation have also been made successfully with the argillaceous limestones of the Lehigh Valley, but no commercial plant has been installed as yet. A finer size of grains in the rock has called for some variations in the process. Similar experiments have been performed on a siliceous limestone from the Middle Western United States, and also on a shell marl high in silica from Australia.

Advantages of limestone processing appear to be: conversion of previously unusable stone to usable and increase in available supplies; elimination of purchasing high-grade rock; reduction in cost of quarrying and of grinding raw rock; saving of fuel; reduction in cost of grinding clinker; improvement in cement quality; ability to produce different products; and sale of materials separated from limestone. Against these are the disadvantages of the first cost of the plant and that of operating it, and the value of the stone discarded.



Some Ore-bearing Fractures

IN 1922 Morey made experiments in which he observed the cooling of a molten system containing H_2O, 9.1 per cent; K_2O, 17.3 per cent, and SiO_2, 73.6 per cent. This system was confined in a bomb; was fluid at 500 deg. C. and exerted no vapor pressure. In cooling to 420 deg. C. a large part of it crystallized, and at that temperature much of the water had separated from the crystals and remained as steam, which built up a pressure of 4,998 lb. per square inch, a force sufficient to lift nearly one mile of granite.

A cooling granitic magma containing considerable water when crystallizing to form anhydrous minerals will expel water and other volatile constituents, and these at the solidification point of granite, which is about 600 deg. C., will exert a high vapor pressure, supposedly great enough to lift two or three miles of granite, according to W. H. Emmons, professor of geology at the University of Minnesota, Minneapolis. Thus it appears probable to him that cooling granitic batholiths, which supply the solutions that deposit the majority of the lode ores of the earth, also on cooling form many of the fractures that become the ore channels.

Briefly, according to Professor Emmons, some of the major events believed to attend the rise and cooling of a batholith may be stated in supposed chronological order as follows:

1. Rise of batholith by thrusting, fluxing, and stoping. 2. Release of fluids and some contact metamorphism around certain supersaturated magmas (probably few at this stage). 3. Solidification of border phase formed before much differentiation of magma has taken place and which therefore is generally more basic than the main batholith. 4. Rise of light salic crystals, fall of heavy femic crystals, differentiation to form masses of granitic magma which contains a concentration of the chief volatile constituents of magma. 5. Solidification of the hood around the top of the still partly liquid core of batholith and further crystallization of the core. 6. Rise of pegmatites into hood and roof of batholith. 7. Rise of steam bubbles and metalliferous volatile materials from liquid core to form cones of gas or of gas-charged magma at pinnacles or high parts of core. 8. Failure of hood and roof which form the container for the gas-charged magma and fracturing of cupolas of batholith, so that fractures generally are systematically disposed in and about cupolas and projecting fingers of the hood of the batholith. 9. Continued cooling and crystallization of core of batholith with volatiles boiling out of the main mass to liquefy in fracture channels, where they deposit ore in fissures and replace wall rocks along them. Collapse at places of small areas above pinnacle cones of gas or of gas-charged magmas and subsidence due to shrinkage resulting from cooling and from expulsion of gases from pinnacles. 11. Cementation by ore of collapsed areas and of later fractures that form where the hood has become tight, so that high vapor pressure again may be built up. 12. Solidification of the base of batholith cutting off any additions of metalliferous fluids from a deep source. 13. Progressive downward solidification of the barren core. 14. Fracturing of barren core. 15. Deposition of pegmatites without metals, of barren quartz veins and of pracaically barren quartz pyrite veins in the core of the batholith. Volatiles still escape from the core but do not carry appreciable metals. 16. Solidification of the core of the batholith is completed.

Iron Ore Beneficiation

IN THE LAST DECADE, approximately 25 per cent of Lake Superior ore shipments has been beneficiated, according to E. W. Davis, superintendent of the Mines Experiment Station, at Minneapolis. About half of it has been simply crushed and screened, this improving structure primarily, and sometimes the analysis slightly. The other half is concentrate, the analysis having been improved materially. Concentration operations are more complicated and in the future will be much more important than the crushing and screening, because of the huge tonnage of low-grade ore available, averaging probably around 30 per cent.

Crushing and screening plants are to be found on nearly all the iron ranges. The shipping ore is usually minus 6 in. Washing, so-called, consists in washing (or scrubbing) the fine low-grade material away from the coarse high-grade lumps. Most of the concentrate produced on the Mesabi is made in washing plants, a desirable furnace product resulting.

Jigging plants on the Mesabi produce several hundred thousands of tons of concentrate annually. Jig ore differs from wash ore in that it must be crushed to 1 in. or finer to free the iron from the silica. Crushing yields four constituents: dense hematite, porous hematite, dense silica, and porous silica. A good jig ore should contain a small proportion of porous hematite and dense silica. These are hard to separate and will go therefore into an at present unmarketable middling. These plants crush to minus 1½ in., wash out the low-grade fines, and screen to several sizes, each of which is then jigged separately.

Magnetic concentration was attempted a number of years ago on the low-grade hard, dense magnetite of the eastern Mesabi. After crushing to minus 6 mesh and cobbing out a third as tailing, the rest was crushed to minus 150 mesh and concentrated in magnetic log washers at a 3-to-1 ratio. The concentrate was dewatered and sintered. Drying and sintering are practiced on the Cuyuna range, this removing all free and combined water and yielding a high-grade material of good structure.

In the last few years, some interesting developments have taken place. Different types of jigs have been used, giving future promise of an increase in this mode of treatment. Likewise, the Hydrotator and the Rheolaveur separator have been employed to a limited extent. A new plant has also been started recently for the roasting and magnetic concentration of minus ¼-in. jig tailing. This is roasted in a shaft-type magnetic roasting furnace and then concentrated magnetically. The venture is experimental.

The future of the district will depend largely upon the extent to which the low-grade ores are used. A 35-year supply of direct furnace ore is known to be available. Many factors other than technical difficulties will effect the establishment of a low-grade iron-ore industry, among them taxation. The St. Lawrence Deep Waterway will enable foreign ores to be brought in greater abundance to the lower Lake furnaces. Moreover, the use of scrap iron and steel will lessen proportionately the demand for ore.

Jigs will be used more extensively, and several new types are being developed. Iron-ore jigs must produce a large quantity of concentrate and a comparatively small amount of tailing. The need of various auxiliary apparatus where jigging is used constitutes a problem, where tonnage is large and costs must be low. Although tabling has disappeared, new and improved types of tables may prove useful.

The chief difficulty in magnetic roasting has been in low roasting efficiency and high fuel consumption. The new shaft-type roasting furnace, already mentioned, may prove satisfactory. In connection with it most of the heat given up in cooling the hot ore is recovered. Fuel oil is used. A cheaper fuel (natural gas), if obtainable, will permit cheap concentration of what has

been considered to be worthless material.

Experiments have been made with flotation, which may yet prove useful. Likewise, leaching of manganiferous iron ore has been worked out and the process is available when prices and demand warrant. Encouraging results have also been secured from an experimental reverberatory smelting process developed for reducing material too fine for the blast furnace. With the waste heat, it is proposed to generate electric power, which will be used to convert the furnace metal into steel in electric furnaces. The production of sponge iron from fine concentrate has also been tried in the United States, but not yet successfully.

Gold at Hog Mountain

ONE company, the Hog Mountain Mining & Milling Company, is operating in the Hog Mountain district, in north-central Tallapoosa County, Ala. The Hog Mountain mine, discovered in 1839, was worked at irregular intervals until 1890, when it passed into new hands, under which control it operated continuously from 1893 to 1915. The more easily treated oxidized ores being then depleted, the mine was idle until August, 1933, when the present company, which controls 1,658 acres of ground, began work. The amount of gold produced prior to 1890 is unknown. From 1893 to 1915 it totaled about $250,000. That derived from present operations has not been divulged, although concentrates are being shipped regularly. The district has been reported on several times. The present paper, by C. F. Park, Jr., is based on field work begun a year ago under PWA auspices.

Hog Mountain is a conspicuous ridge, 1,000 ft. high above sea level and 400 to 500 ft. above the surrounding country. It consists of a granitoid schist. The climate is mild and rather humid, with an annual rainfall averaging 55 in. Two rock formations have been distinguished: the Wedowee, of fine-grained dark-gray graphitic schists, and an intrusive quartz diorite of unknown age. The intrusive body, in which are the gold-bearing veins of commercial significance, occupies an area about 4,800 ft. long and 800 to 1,300 ft. wide. Metamorphic effects are slight. The paucity of mineralization at and near the contact indicates that the mineralization is later than the intrusion. The mineralization not only took place in such openings as existed, but in many places the quartz diorite was replaced.

At least sixteen well-defined veins, among them the Blue and the Barren, are partly developed by surface cuts and shallow workings. In addition there are many others. The maximum vein width noted is 20 ft., exhibited on the Blue vein. Veins 3 to 8 ft. wide are common, judging from abandoned stopes and accessible exposures.

Veins of economic importance are confined almost entirely to the quartz diorite. Toward the contact they commonly split into stringers, which pinch out. In a few places they widen into pipe-shaped orebodies near the contact. The gold veins exposed are of the deep-vein zone type. Much gold has probably been lost by erosion. No placer deposits have been found.

The most abundant mineral in the veins is quartz. Sericite (muscovite) also occurs extensively. Pyrrhotite is the most abundant sulphide. Chalcopyrite and arsenopyrite are found in small amounts; pyrite occurs only rarely. Zinc sulphide occurs in small quantities in much of the ore; also a small amount of lead and traces of silver. Other minerals include marcasite, manganese oxides, native sulphur, and limonite, the last being abundant.

Gold, as found, is finely divided and, at least in part, intimately mixed with or inclosed in the sulphides. No free gold has been seen save in the flotation concentrate under the microscope.

The veins now worked are opened by a 215-ft. shaft and by about 1,500 ft. of development on the 100-ft. level and about 600 ft. on the 200-ft. level, in both cases on the Blue and Barren veins. No work has been done below the 200-ft. level. Extraction is by shrinkage stoping, which is generally satisfactory. The ground stands well. Timber used is mostly short-leaf pine and white oak, abundant locally.

Methods of milling the local ores have not been studied extensively. After experimentation the present operators installed flotation. Changes in the flowsheet are constantly being made. A peculiarity of the ore is the rapidity with which the sulphides oxidize. Flotation concentrates, after being dried and stacked, become warm in a day and turn to a hard red clinker within a few days. They are shipped in sheet-iron cans by truck to Alexander City, 13 miles away, and thence by rail to the Nichols Copper Company's plant in New York City.

Skilled miners are scarce. Unskilled labor, white and colored, is abundant and is paid $1.50 per day and up. Labor turnover is high. Water is pumped from a stream a mile distant. Power is supplied by the Alabama Power Company from Alexander City.

Aviation in Engineering Geology

GOING UP in the air in order to see into the ground is a paradox explained by the use of the airplane in analyzing the geological structure of the earth. Observations from the air, oblique aërial photographs, and vertical photographs studied with the stereoscope all have their use in geological surveys. The value of these methods in mining and petroleum investigations is now well recognized, but their use in connection with civil engineering projects is not so common. Hence the value of a paper by Irving B. Crosby in which he reports the application of aërial methods in the location of dam sites.

Geological reconnaissance from the air is particularly useful as an aid to subsequent ground work, and is specially valuable in unmapped territory or regions of wilderness where progress in ground work would be extremely slow. For civil engineering projects such as the location of power sites, transmission lines, reservoirs, roads, quarries, and sand and gravel deposits, aviation offers a new and valuable tool. Not only is time saved, but a clearer understanding is gained of the geology of the region in its relation to the practical aspects of the problem under investigation.

In this paper the author gives briefly the results of his own experience in using aërial methods for the selection of the best six out of twenty-seven possible dam sites in the St. Maurice valley, in Quebec, Canada. The location of faults, former stream courses, buried gorges, moraines, and other glacial deposits, and the present drainage pattern, are quickly studied from the air and serve to direct ground work with the least loss of time and energy.

The headwaters of the St. Maurice are on the Laurentian peneplain far to the north of the river's mouth, in the St. Lawrence. The country is rugged, forested, dotted with lakes, sparsely settled, and practically unmapped. From the air the course of the river is seen to comprise a series of stretches at approximately right angles to one another. This rectilinear drainage pattern suggests structural control. The irregular course of the river also indicates that the stream is not flowing in its pre-glacial channel. By reconstructing the pre-glacial drainage system it appeared that, prior to the last glaciation, this region was drained by several streams flowing from northwest to southeast and that the present St. Maurice is made up of parts of five different streams.

In selecting dam sites one of the most important problems was to locate buried gorges and determine without borings whether rock was near the surface. The author gives several examples of applying the results of his aërial geological studies in the selection of dam sites, but the details are difficult to follow without a good map of the area. It is important to note, however, that thus far some of his aërial observations have been confirmed by borings. One dam has already been completed at a site which was selected from the air.

A Million Tons of Potash

IN A REVIEW of the current position of the United States as a potash producer, H. I. Smith, of the United States Geological Survey, pictures the outlook for the growth of the domestic potash industry. His paper supplements one presented before the A.I.M.E. in February, 1933, and a more comprehensive review in *Engineering and Mining Journal* in December, 1933.

The groundwork of the present domestic industry was laid by the Geological Survey in its study of the Permian basin of Texas, New Mexico, and Kansas as a commercial source of soluble potash minerals. On the discovery of sylvite, potassium chloride, in New Mexico, in 1925, sufficient financial interest was aroused to bring about a new era in American potash production by 1932. Today private enterprise has developed the deposits in the Carlsbad (New Mexico) area for a production of more than one million tons of crude salts annually.

Sixty core tests have been drilled in an area of about 100 square miles lying 20 miles east of Carlsbad. Here beds of sylvite 4 to 12 ft. thick containing an equivalent of 14 to 37 per cent K_2O have been located in an area of 35 square miles. Reserves have not been recalculated since 1932, when three subordinate areas of high-grade salts were conservatively estimated to contain more than 100,000,000 tons of crude salts of 14 per cent K_2O.

In addition to the chloride salt, sylvite, at least five cores have revealed the occurrence of langbeinite, anhydrous potassium-magnesium sulphate containing, when pure, 22.7 per cent K_2O. The economic value of this occurrence has not yet been appraised, but it holds possibilities of importance because the United States now imports practically all its consumption of sulphate of potash.

Producing companies in New Mexico are the United States Potash Company and the Potash Company of America. Others active in prospecting and drilling are the New Mexico Potash & Chemical Company, Kroenlein and associates, and the General Potash Company, formerly known as the Texas Potash Corporation, of Colorado.

The United States Potash Company has two shafts about 1,000 ft. deep. Mine capacity of 100 tons an hour is limited by the grinding plant. The refinery can produce 400 tons of refined muriate per day. The Potash Company of America has one shaft completed to a depth of 1,100 ft. and another was begun last October. A concentrating plant for the separation of sylvite from halite by ore-dressing methods will use a process developed cooperatively with the Bureau of Mines. The first unit of the mill now in operation has a capacity of 50 tons per hour.

The economic development of the domestic potash industry, as with many others, is affected by international competition, cartels, import restrictions, dumping, and all the other devices growing out of the wave of nationalism that has swept over the world. Foreign development of potash since 1932 has been as rapid as in the United States. Spain and Russia have been successful in capturing a part of the American trade, although France and Germany are still the principal sellers. Without tariff protection of any kind American potash producers have had to meet a trend toward lower world prices and overdevelopment of world resources. They are practically excluded from foreign markets and must meet vigorous competition at home. The present outlook is that for 1934 they will have captured less than 50 per cent of the American market. As soon as American operators start production of sulphate as well as muriate they will be in a more advantageous position both at home and abroad.

The Refractories Industries

SUBJECT to such highly practical considerations as ability to withstand slagging, abrasion, and spalling, as well as the various other stresses and physical phenomena induced by heat, of which softening or incipient melting is only one phase, the definition of a refractory material is based upon temperature resistance. Broadly speaking, according to Paul M. Tyler, of the United States Bureau of Mines, and R. P. Heuer, of the General Refractories Company, any material which shows obvious signs of fusion after being heated slowly to 1,500 deg. C. cannot be classified as a refractory.

The iron and steel industry is the leading user of refractories, accounting for half the total sales. Next are the public utilities and the power-generating stations, which, grouped together, account for 20 per cent. The remaining 30 per cent is divided among a great variety of consumers, prominent among which are the non-ferrous metal industry (6 per cent) and cement and lime manufacture (5 per cent).

The typical refractory product is supplied in the form of brick and preformed shapes. Silica standard shapes are appreciably the same as firebrick, and magnesite, chrome, and special or high-priced refractories are available in a more limited range of sizes and shapes. Ordinary siliceous sand, grain magnesite, dolomite, chrome ore, and certain other materials are purchased in bulk. Various refractory cements or mortars, for making joints, and plastic mixtures, for either repairs or making monolithic structures, are also available.

Common refractories may be classified thus: fireclay, silica, high alumina, chrome, and magnesite. The first are the cheapest and constitute the largest tonnage. Silica refractories form the next larger group, and cost somewhat more than fireclay products. High-alumina brick, chrome brick, and magnesite brick follow in order of increasing cost. Still more expensive are those refractories which include the synthetic materials, such as silicon carbide and fused mullite, also fused alumina, fused magnesia, and other electric furnace products, with special refractories made from comparatively expensive raw materials, such as zirconia, beryllia, and thoria.

According to the raw materials required, the refractories industries are roughly divisible into those making fireclay and silica refractories (relatively cheap tonnage products) as a major group and those producing the highly diversified, high-duty refractories.

Fireclay brick are made in general by hand molding, stiff-mud repressing, and dry-pressing, the three principal raw materials being flint clay, bond clay, and grog or calcine. Silica brick are made by hand-molding, machine-molding, and dry-pressing. Ganister is the essential raw material. Magnesite brick are available in burned and unburned form. The principal raw material is dead-burned grain magnesite. Chrome brick are largely made in the same way as magnesite brick and may be burned or unburned. High-alumina brick are made in general like fireclay brick, save that burley and diaspore clays are substituted for flint clays and the brick are burned at a higher temperature. Zirconia brick are usually molded in a dry press from crushed ore, with fines as a

binder; silicon-carbide brick usually from properly sized grains bonded with fireclay.

Production of refractories is well established in Germany, Belgium, Great Britain, France, Italy, and the United States. Other countries have industries of at least local importance. Complete statistics as to output in the United States are not available. Available data indicate that under pre-depression conditions the value of domestic refractory products reached $90,000,000 to $100,000,000 annually. Employees have been estimated at 20,000. Plant capacity exceeds domestic needs, even in active years. Production of refractories is closely correlated with that of iron and steel. Shipments of fireclay, as reported by the United States Bureau of Mines, supply a good barometer as to the industrial status of the refractories industries.

Clay firebrick were made in 1929 in 198 establishments in the United States. In 1930, 147 companies operated 222 plants in 27 states. Much of the output came from about twenty large corporations. With three other states, Pennsylvania accounts for more than 80 per cent of the total value of all refractory products.

Imports of manufactured refractories have been relatively small and appear to be getting smaller. Magnesite, chrome, and fireclay brick in general have some degree of tariff protection. Exports of firebrick and refractory shapes have recently averaged around $2,000,000 per year. Prices have been altered at rather infrequent intervals, despite widely varying trade conditions.

A Geophysical Atlas

SUCCESSFUL EFFORTS to persuade the International Union of Geodesy and Geophysics to sponsor the project of creating a geophysical atlas were described in a paper by E. Rothé, director of the Institute de Physique du Globe, of the University of Strasbourg, and secretary of the International Association of Seismology. Interested governments and companies conducting important geophysical prospecting campaigns were invited by the Union in 1930, upon Mr. Rothé's suggestion, to communicate to it the results of their drillings and maps, summarizing the work, to the end that in this way a geophysical atlas, complementing the geological maps, could be built up. Such an atlas, it was said, would facilitate later studies by prospectors, who would thus be able to compare their interpretation with well-known types of tectonic structures. A committee was also appointed, consisting of one or more members from each country represented in the Union, who undertook the task of gathering the results of scientific prospecting in their respective countries.

The data thus to be assembled included: geological information and drilling results; maps of the work; indication as to the methods used and the degree of precision attained; and the numerical results of the field work. To speed this preliminary work Mr. Rothé has tentatively assembled the necessary documents at Strasbourg, awaiting more definite action to be taken at the next meeting of the Union at Lisbon.

National delegates thus far appointed include the following: For Holland, Mr. Vening-Meinesz, Dr. van Dijk, director of the Royal Meteorological Institute of Holland, and Prof. J. A. Mekel. For Rumania, T. P. Ghitulesco, chief of the prospecting division of the Geological Institute of Rumania. For the Union of South Africa, B. C. Eva, secretary of the Research Grant Board. For the French Colonies, M. Hubert. For Morocco, M. Liouville, with the collaboration of M. Blondel, director of the Bureau d'Etudes Géologique et Minières, and M. Maillet, director of Cie. Générale de Géophysique. For Italy, Mr. Cassinis, secretary of the Italian Committee. Many nations whose work in geophysics is well known, such as Spain, represented by Mr. Siñeriz, are expected to respond to the inquiries. The objective cannot be properly achieved without the help of the United States and Japan, according to Mr. Rothé.

The scientists of Central Europe have also been approached, despite the fact that their countries do not belong to the Union. The Geological Survey of Prussia has informed the Union that the International Congress of Geology has a geophysical section which is gathering the results of research and suggests that the Union would avoid duplication if it first arrived at an understanding with the Congress. The objective of the latter is not exactly understood, however, according to Mr. Rothé, whereas that of the Union is, definitely, to compile a "geophysical atlas."

In conclusion, a complete list of work done in Algiers, Tunis, Morocco, Gabon, and Cameroun was given by Mr. Rothé. Nothing is to be published save the results of scientic work properly controlled.

Woolrocks of Illinois

WOOLROCKS are natural rock materials having chemical composition and physical character suitable for making rock wool. Little of the information acquired about them by manufacturers of the latter has been made public. Recent researches conducted by the Illinois State Geological Survey, however, have presented the first comprehensive picture of the characteristics necessary in a woolrock, according to J. E. Lamar, geologist with the Survey. Although the tests were made in the laboratory, sufficient checks were obtained to suggest a high correlation of the results with those of larger-scale tests.

Inasmuch as rock wool in general is found to contain four major constituents, CaO, MgO, SiO_2, and Al_2O_3, a study was made of the four-component system involving these four oxides, including determinations of the nature and rock-wool-making properties of a large number of synthetic mixtures of varying composition. The conclusion was also reached that a carbon dioxide range of 20 to 30 per cent is accurate enough for delimiting suitable rock materials.

Within the stated range two types of consolidated rock deposits are found in Illinois: (1) those of a single kind of impure rock, such as cherty dolomite or argillaceous limestone, and (2) deposits of interbedded strata of diverse nature, as interstratified limestone and shale. Rocks of the first type are being used commercially; those of the second require engineering research for their evaluation. Unconsolidated rocks falling within the carbon dioxide range given include chiefly the minus 4-mesh portions of glacial gravels, some glacial tills and, rarely, glacial silts. The satisfactory use of these materials depends primarily on the development of suitable process equipment.

Among the rocks of the first group, those limestones and dolomites containing sand or silt grains, small irregular masses of silica, or more or less uniformly disseminated clay particles may offer some advantages over rocks composed of larger lithologic units such as cherty limestone, because of the natural intimate mixture of their constituents. Also in the first group are sandstones and shales with interstitial calcareous and dolomitic material. Deposits of this group are commonly capable of yielding the raw material in good-sized pieces of sufficient hardness to prevent formation of an amount of small stone objectionable in the cupola. Rocks having constituents of dissimilar properties may require special control of the melting process.

The second group of consolidated woolrocks consists of interbedded strata of unlike lithologic character but as a whole of such composition that they have the chemical properties of woolrock. The feasibility of using these rocks in the cupola customarily employed for making rock wool is not known.

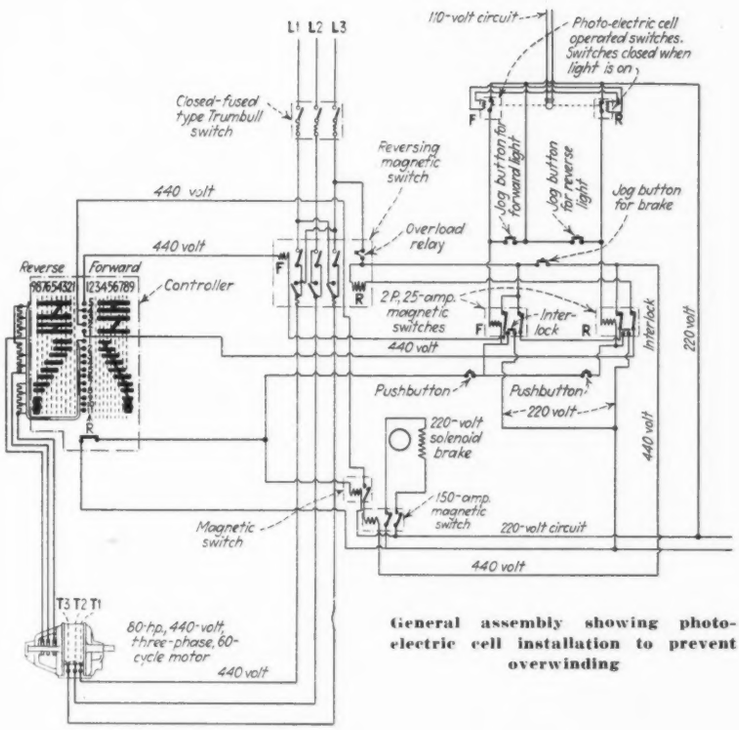
New Accessories

Feature U. S. Smelting Underground Hoist Installations

• Photo-electric cell prevents overwinding . . . Aluminum cages and skips reduce dead loads . . . Loud speaker in hoist room enables operator to hear dumping of skips and to receive signals by radio in addition to bell signals . . . Pre-cast concrete slabs and structural steel used for housing

Gail Martin

Salt Lake City, Utah



General assembly showing photo-electric cell installation to prevent overwinding

WHEN the new Nordberg hoist was installed at the No. 2 shaft of the United States Smelting, Refining & Mining Company, in the Niagara tunnel, at Bingham, Utah, a number of innovations were made that, each day, have been proving their efficiency and economy. These include the construction of an aluminum cage and skip for the purpose of reducing the dead load; the use of steel and pre-cast concrete slabs in place of timbering in the hoist station; and the use of radio as an added safety factor in the operation of the hoist. At the Lark shaft, the company has also proved the practicability of a photo-electric cell and light beam in controlling overwinding.

The hoist at the No. 2 shaft is housed in a steel and concrete chamber 6,300 ft. from the portal and about 600 ft. vertically below the surface. Dimensions of the station are 35 by 66 ft. by 15 ft. high, with an auxiliary chamber 75 ft. long for transformers. Four thousand bags of cement and 25 carloads of steel and other equipment were used in building the station.

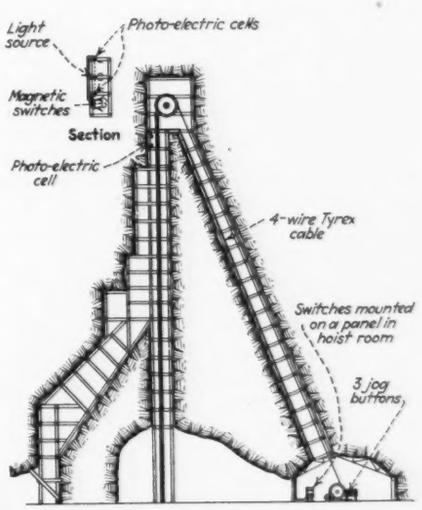
The hoist has two drums, 8 ft. in diameter, with 9-ft. faces that contain two layers of 1½-in. cable on each drum. Three variable speeds are used. A Lilly control provides a maximum safety factor. In the event of overwinding, the current is transposed, so that further movement is away from the point of danger. In hoisting men or ore, the hoist is automatically set to a predetermined point. Automatic brakes are provided to operate in the instance of an accident to the operator or the machine. The Lilly control also gives audible indication of its approach to a predetermined point. In addition, the company has installed radio devices near the dumping pockets. A loud speaker in the hoist room enables the operator to hear the dumping of the skips and receive signals by radio in addition to bell signals.

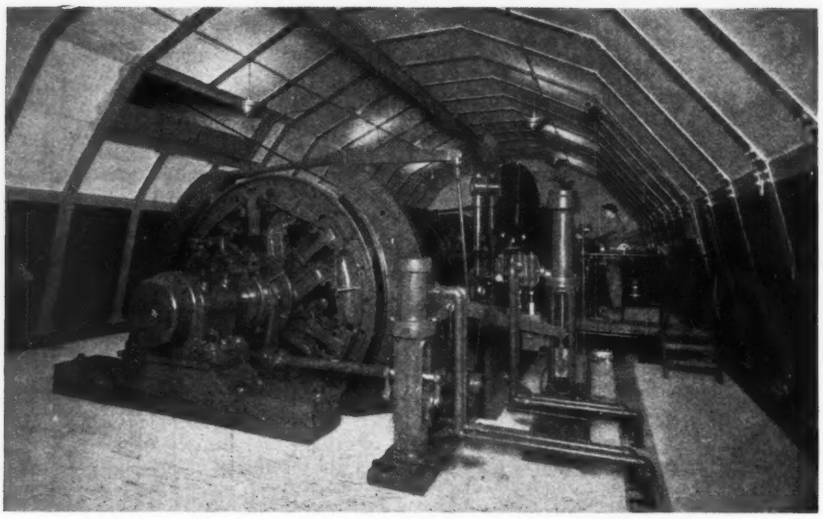
The operation of the new hoist has been considerably improved by the re-design of the skip dump track, practically eliminating the rope shock at this point and minimizing greatly the roller impact upon the skip horns and dump track, which, in turn, means longer wear and lower maintenance cost. Another valuable improvement has been made in designing the equipment so that the guide shoes can be renewed without removing either the skip or cage from the shaft. Guide shoes are faced with ⅜-in. Stellite. When worn, they are readily removed for resurfacing while a new set is easily slipped in place.

Fabrication of the aluminum cage and skip was done in the Midvale shops. Three units were constructed, two for use in hoisting in balance and the third for replacement purposes. The skip, which is of the Kimberley type, has a capacity of 50 cu.ft., 25 per cent greater than the steel skips formerly used. Weight of the aluminum skip is only 1,520 lb., compared with 3,600 lb., the weight of the steel skips previously employed.

The cage consists of steel and aluminum and weighs but 1,980 lb., compared with the 2,700 lb., the weight of the cage formerly in use. Total weight of the

Wiring diagram of photo-electric cell installation





The two-drum Nordberg hoist, installed by the U. S. Smelting company at its No. 2 shaft in the Niagara tunnel at Bingham, Utah. It is 600 ft. below the collar and 6,300 ft. from the tunnel portal

new equipment is but 3,500 lb., compared with 6,300 lb., a saving of 2,800 lb. in the dead load upon the hoisting equipment. This economy means that an additional depth of at least 1,200 ft. can be attained without a change in the size of the rope or the production of greater stress upon the hoist drum.

All suspending and wearing members in the cage are of steel. The enclosure, the floor plates, and the bonnet sheets are of aluminum. Some interesting experiments have been made as a precaution against galvanic action. Although this action has been minimal, the management prefers to withhold data on this work until more time has been made to prove conclusively the correctness of its theories.

At first, the skip was lined with $\frac{3}{4}$-in. sheet rubber, to protect the metal from abrasion and deformation. Later, over the rubber sheets, $\frac{3}{16}$-in. high-carbon steel plates were fastened loosely enough to deflect freely when the ore was dumped in the skip. By taking advantage of the difference in the moduli of the steel and the aluminum, no excessive deformation of the skip has developed, notwithstanding that the ore is a heavy-sulphide type. In designing the equipment, the weight of the ore was computed at 160 lb. per cubic foot.

In construction of the hoist room, the use of timber and of lumber forms for concrete was entirely obviated by the substitution of structural steel and precast concrete slabs. Slabs 3 ft. 7 in. long, 4 in. thick, and $9\frac{3}{8}$ in. wide at the front face and $7\frac{3}{8}$ in. wide at the back face were cast at the Midvale plant of the company. When the structural steel work was completed, these slabs were hauled into the mine. Two men were able to handle the slabs and place them on the beams. Grouting was then filled in between the slabs and the rock walls, the concrete filling the grooved edges at the ends of each slab so that the whole roof and wall, when set, was converted into a monolith.

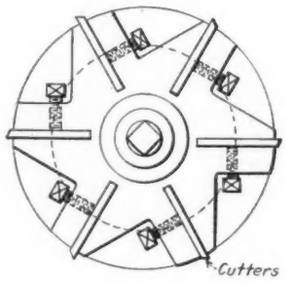
The concrete slabs were designed so that a load which would cause the slab to break would develop in the structural steel member supporting the slab a stress less than the yield of such a member. In that way the slabs would undoubtedly give warning, should excessive loads be developed; and, by removing such broken slabs, the pressure could be relieved and the structure repaired without any damage to supporting members. Wire mesh was cast in each slab so that in the instance of a fracture of a slab by reason of excessive load, which might develop from the swelling of ground, no large pieces would fall on men working below.

For the purpose of testing the efficiency of the photo-electric cell as hoist-control equipment, the management has made such an installation at its Lark shaft. During a year of steady service the installation has thoroughly proved its quick action and efficiency. The installation, as shown in the accompanying sketches, consists of an ordinary electric light placed on one side of the shaft, with a lens focusing the light into a beam. On the other side of the shaft, a photo-electric cell has been fixed. When the hoist passes through the light beam, a solenoid brake is automatically set and overwinding prevented.

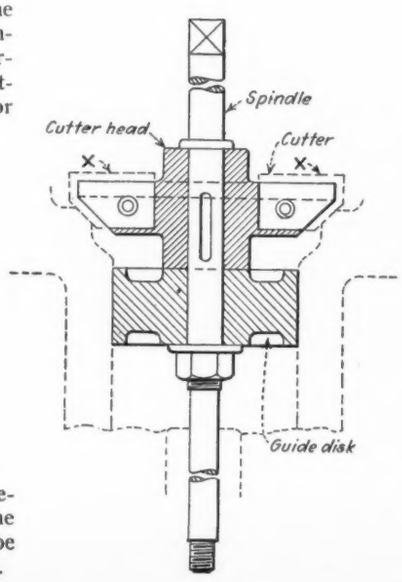
A Valve-Seat Cutter for Emergency Use

WHILE overhauling a 150-hp. gas engine after one year of practically continuous service, W. S. Morrit, master mechanic of a mining company operating in central Mexico, was confronted with the problem of badly worn inlet and exhaust valve seats. When appropriate tools are at hand this is a simple matter, but in this instance the reamers available at the machine shop were too small. Two ways were open to solve the problem: (1) to send the cylinder heads to the nearest manufacturing center, which was out of the question because of the high costs involved, and (2) to make a cutter or reamer locally.

The device shown in the accompanying sketch resulted. Essentially it consists of a steel spindle, the cutter head in which rest the six knives held in place by steel setscrews, and a guide disk to prevent chattering. To insure uniform pressure upon the knives it is well to make the lower part of the spindle long enough to permit attachment of the valve spring or a counterweight. The knives also have a cutting edge at *X* and can be utilized for



milling horizontal valve seats or for removing incrustations by turning the cutter head. The device can be actuated by hand or by a power drill.



Surface equipment for sinking small vertical shaft. With such a plant the work described in the accompanying text was done

Sinking a 200-Foot Prospect Shaft For $3,000

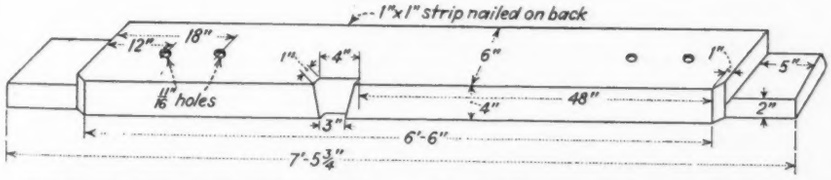
Two-man crew complete work in 98 days including cutting out for stations—Timbering is simple

Charles Labbe

Death Valley Junction, Calif.

ALL HAVE READ of the sinking of large shafts, with their facilities for mucking, their timbering, their advantages and drawbacks. A large number of mine owners are also interested in small shafts for prospecting and their cost. In the Southwestern United States, where recently many properties have been opened, the sinking of a shaft that is small but deeper than can be served by a windlass is often the principal work required for the development of a prospect. Data relating to such a project are presented here. They demonstrate that even during a depression the right crew at the right price will be cheapest for excellent work. This shaft was sunk at a gold prospect 30 miles west of a station on the Tonopah & Tidewater Railroads, the climate and accommodations being typical of all desert prospects.

Equipment for sinking to a depth of 251 ft. consisted of a hoist powered by a 20-ft. tractor engine, a 6x8-in. vertical compressor, belt-driven from a 40-hp. tractor engine, both power plants being well suited for prospect work; also jackhammers of the smaller pattern with the necessary drills and accessories.



Detail of shaft wall plate. Those used on this job were of Oregon pine. After being framed on the surface each set was assembled and tried for fit at the corners before being sent down the shaft

A vertical windlass shaft 5x7½ ft. had been sunk to a depth of 50 ft. on a quartz vein nearly as wide as the shaft. The formations consisted of layers of schist, quartzite, and shales, with sills of intrusive plutonic quartz related to the ore veins. The beds, dipping 30 deg., varied in hardness from soft slate to massive quartz, all drilling, breaking, and standing well.

The headframe, 25 ft. high, was built locally at a total cost of $165, the size being governed by the purpose of the intended work—namely, the opening of a prospect.

The bucket dumper was a plain sheet of iron hinged at the lower part and slotted at the upper end to catch the tail chain. It was counterweighted and operated with a rope by the hoist engineer.

Two men, a hoist engineer and a top man, were on the surface at all times. When mucking was being done, they were kept busy with hoisting, closing the doors and tramming. While drilling and timbering were going on in the shaft, they sharpened tools and framed timbers.

Inasmuch as only two men could work in a shaft of this size, to make progress they had to be skilled shaft men, because drilling, mucking, and timbering were all done by them.

Drilling took 2¾ hr., including lowering of hoses and drills, drilling, removal of drills and tools, and loading. For blasting eight to thirteen holes were required, according to the ground. The main objective was to break the round squarely to the bottom and to have less picking.

Powder per round averaged 40 sticks of 1⅛x8-in. 40 per cent dynamite. There was no water and any ordinary fuse did well. Both No. 6 and No. 8 blasting caps were used, and in such ground showed no difference.

Because the nature of the ground did not call for more than the legal requirement of a tight shaft, the timbering was simple. Wall plates and end plates were 4x6-in. Oregon pine; crosshead guides, posts, and spreaders 4x4 in.; laggings light 2x12-in. boards. Details of the wall plate are given in a cut. Station sets, also partly serving as bearer timbers every 50 ft., were 6x8 in. Height of station was 6 ft. 8 in., leaving 43 ft. 4 in. to be divided into eight sets, which made the shafts sets 5 ft. 5 in. between centers. Lagging was 5 ft. 4 in. long; corner posts were 5 ft. 1 in.; and vertical ladders 18 ft., alternated every third set with a 2x12-in. platform. This gave a 4x4-ft. hoisting compartment and a 2 ft. 2 in. ladderway, which proved ample for the purpose.

Lagging was held mostly by a keyboard, a 2x6 or a 2x8 running the whole length and wedged at several places. When the ground was loose, it was necessary to fill back with odds and ends between lagging and wall. Corners of each set were plumbed directly from the top, as was also the center of the opposite end plate, which was marked in the middle. After being framed by the surface men, each set was assembled and tried for fit at the corners and marked "1," "2," "3," and "4," before being sent down.

Timbering of one complete set took 6 hr. Mucking, using a straight 1,100-lb. bucket (105 shovelfuls) took 6 to 7 hr., drilling and blasting 3 hr. A complete set at this rate has taken two shifts. A total of 201 ft. of sinking was done in 98 days, the extra time being spent in the starting of the stations.

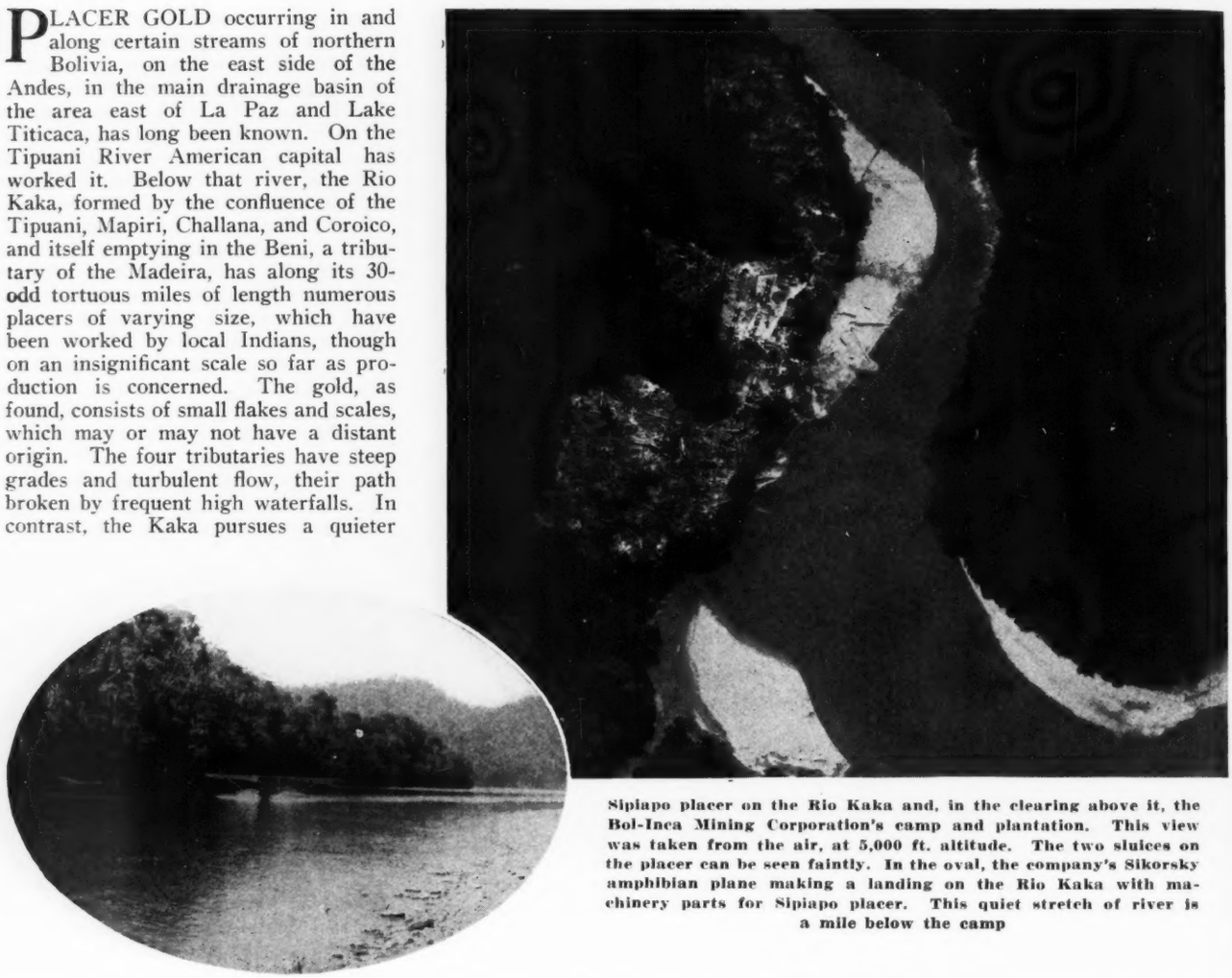
Total cost for sinking this 201 ft. was $3,043.45, the details being as follows:

Labor	$2,267.50
Insurance	135.00
Lumber	381.35
Explosives	175.00
Lights	6.60
Gasoline	35.00
Oil, grease, blacksmith coal	9.65
Pipes, bolts, nails	33.35
Total	$3,043.45

A Placer Mining Venture on

Air Transport Plays an Important Part in the Movement of Equipment and

PLACER GOLD occurring in and along certain streams of northern Bolivia, on the east side of the Andes, in the main drainage basin of the area east of La Paz and Lake Titicaca, has long been known. On the Tipuani River American capital has worked it. Below that river, the Rio Kaka, formed by the confluence of the Tipuani, Mapiri, Challana, and Coroico, and itself emptying in the Beni, a tributary of the Madeira, has along its 30-odd tortuous miles of length numerous placers of varying size, which have been worked by local Indians, though on an insignificant scale so far as production is concerned. The gold, as found, consists of small flakes and scales, which may or may not have a distant origin. The four tributaries have steep grades and turbulent flow, their path broken by frequent high waterfalls. In contrast, the Kaka pursues a quieter course, with rapids of an average fall of about two feet alternating with almost flat stretches of a few hundred yards or occasionally more in length.



Sipiapo placer on the Rio Kaka and, in the clearing above it, the Bol-Inca Mining Corporation's camp and plantation. This view was taken from the air, at 5,000 ft. altitude. The two sluices on the placer can be seen faintly. In the oval, the company's Sikorsky amphibian plane making a landing on the Rio Kaka with machinery parts for Sipiapo placer. This quiet stretch of river is a mile below the camp

Midway down the Kaka, a 5-mile stretch is held under claims filed by the Aramayo company. Save for a short stretch at the beginning of the river's course, near the town of Guanay, the ground along the rest of the stream belongs to the Bol-Inca Mining Corporation, of New York, organized a few years ago by R. A. O'Neill, now president, and his associates. Seven mineral concessions have been acquired by staking and filing and three of them patented, the latter totaling 4,522 acres. The company's holdings include about 25 playas, or placers. At one point, on the so-called Sipiapo placer, a camp has been established, two sluices have been built, and four test runs, totaling 1,500 cu.yd., completed, the gravel coming from test pits sunk at intervals between the sluices. Only the top 12 ft. of this 50-acre placer has been thus sampled, the ground below this level being waterlogged to bedrock. This constitutes the principal sampling thus far done, according to Mr. O'Neill, the remainder being confined to the shallow (2 to 4 ft. deep) native diggings said to be numerous all along the river.

The gold content of all samples taken has varied widely. Rich streaks are encountered at times, running exceptionally high in gold. It is also stated that the Indian diggings have shown values ranging from 50c. up per cubic yard. On the strength of the results obtained from the work it has done, the company is installing a Sauerman slack-line excavator having a ¾-yd. bucket and a rated capacity of 1,000 cu.yd. per 24-hour day; an 8,000-lb. rope-pull Lambert hoist, and a 3,000-g.p.m. single-stage double-suction Goulds centrifugal pump. The excavator will be used for further sluicing. The company also has the parts for a small New Zealand-type dredge, of a rated capacity of 1,200 cu. yd. per day. For it a wooden hull is being built, from local hardwood, cut with an "American" sawmill.

Boulders are said to be numerous, statements differing as to their size. Further test work on the other placers should make it possible to appraise the difficulty they may offer to dredging operations. Those on the Sipiapo placer are reported to be of moderate size, such as will not prohibit dredging, and boulders on the placers downstream are smaller.

Some years ago, a British and French enterprise, the Incahuara Dredging Company, brought a small dredge from Scotland, which was installed on the Kaka, after tremendous difficulties. The enterprise failed because of insufficient capital.

Entry into this region by the Bol-Inca

the Rio Kaka

Supplies in Northern Bolivia Project

company has been effected from across the mountains to the west. Air transport has played a part. Between Sipiapo, at 1,500 ft. elevation, and La Paz, the capital, on the plateau 12,000 ft. high, lie mountain ranges 18,000 to 22,000 ft. in height, the lowest passes reaching 16,000 ft. Equipment and supplies are trucked from La Paz to Sorata, 90 miles by road, and thence taken across the range by mule and down the river by balsa raft, a long, arduous journey. Provisions and other food and some hardware are brought from Sorata. Pieces of equipment too heavy for mule to carry have been flown in by air, the company having its own plane. This is an S38 Sikorsky amphibian, carrying a 2,000-lb. pay load and a useful load (pilot and gas) of 4,000 lb. Cruising speed is 100 miles per hour. The engines are supercharged to give a service ceiling of 19,500 ft. The plane with its load must be able to climb to 18,000 ft. to negotiate the 16,000 ft. pass in comfort. Its body has been conditioned for carrying freight.

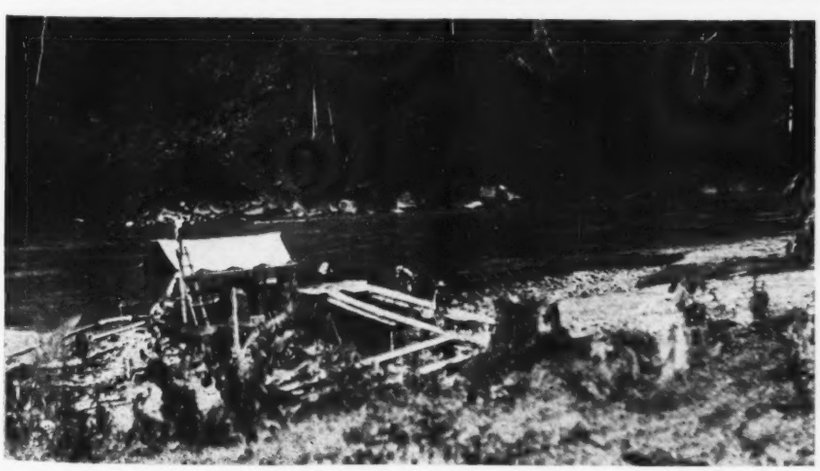
La Paz has the highest airport in the world. The field is a mile from the town, which is in a canyon, and 1,300 ft. above it. Fully loaded, the plane requires 54 sec. to take off. The trip to Sipiapo is made in 75 to 90 min. via Sorata Pass. Landing is made on a quiet stretch of river 1¼ miles long and ¼ mile wide, a mile below the camp. After being unloaded, the plane takes off empty in from 15 to 20 sec.

Should future circumstances warrant, heavy equipment could be taken in from the east—up the headwaters of the Amazon to Rurrenabaque on the Beni, 75 miles by air from Sipiapo and about 900 ft. above the sea, according to Mr. O'Neill. Under these conditions, the pay load could be doubled and flying time cut in half.

Hydro-electric power sites are available on the tributaries of the Kaka, according to Mr. O'Neill. Labor supply at present is not abundant in the region. Local natives are indisposed to work for hire. Men have been imported from some distance. In all, 125 men were employed in 1934.

Upper view — Indian diggings on Mariara placer. Such shallow diggings are common all along the river. Each year the spring floods cause them to fill up again

Lower view—One of the two sluices on the Sipiapo placer. Both have been used for testing purposes, having handled 1,500 cu.yd. of gravel taken from pits thus far



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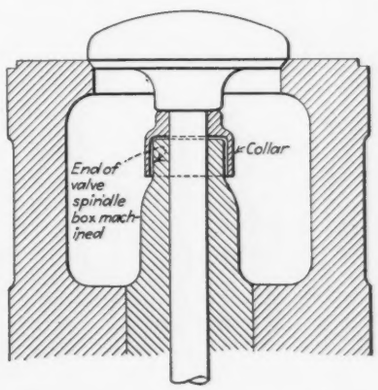
Avoiding the Jamming of Exhaust Valves



Diagrammatic detail of valve collar

RAPID WEAR of exhaust valve spindles and frequent jamming of the valves proper of a 150-hp. gas engine caused considerable annoyance and delay at the property of a mining company in northern Mexico, writes T. W. Allmand, master mechanic of the company. Generally, the trouble would start after ten or twelve days of continuous engine performance.

Taking the valves apart disclosed that the hot gases forced into the exhaust chamber of the valve during the exhaust period also entered the void between the valve spindle box bushing and the valve spindle proper, gradually depositing therein dust and other foreign matter held in suspension. This continued until the lubricating channels were covered with this matter and the valve finally jammed. To surmount this difficulty, the valve spindle was provided with a bell-shaped collar which covers the machined end of the valve spindle box, as illustrated in the accompanying sketch.

Recovering $500,000 With $5,000

The Story of a Successful Tailings Re-treatment Operation

A. E. Place

Mining Engineer
Los Angeles, Calif.

WITH gold selling at $35 an ounce, and capital harder than ever to get for mining ventures, the study of small, profitable mining enterprises which have paid big returns on small investments should be of great interest. The following description of a little tailings plant that yielded a gross return of $500,000 in gold bullion, and a net operating profit of more than $400,000 in three years, with a single capital investment of $5,000 in equipment and payrolls, will give some idea of what can be done by a competent operator working under favorable conditions with suitable ores.

The plant was near Johannesburg, in the Randsburg district, Southern California, and was owned by the proprietors of the old Red Dog custom mill, the Stanford Mining & Reduction Company, of Los Angeles. Fred W. Carlisle, an experienced mill man, who later became chief chemist and assayer for the California Rand Silver Mines, designed, built and operated it from 1907 to 1910. Although I was familiar with the operation, I am indebted to Mr. Carlisle for much of this detail.

The plant was built to leach with cyanide about 70,000 tons of sand and slime, the tailings from the Red Dog mill near by. They came from the treatment of gold ores, originating in the Randsburg, Johannesburg, Mohave, and other camps. These ores varied greatly in gold content, as they came from widely scattered mines. The mill heads averaged between $20 and $25 a ton, of which two-thirds could be recovered by amalgamation in stamps and on plates, the residue going to waste. This gave an average of a little over $7 a ton to the tailings, 95 per cent of which was gold and the rest silver. The Red Dog mill had ten stamps and crushed to 40 mesh. There was no concentration equipment. The gold in the tailings was locked up in sulphides or in insufficiently ground ore particles. The tailings were separated with cone-shaped settlers into sand and slime, the former being trammed to the dump and the latter run into a slime pond. Most of the slime would pass a 200 mesh screen. It was sticky and caked when dry, and constituted 40 per cent of the total tailings. Sand and slime assayed alike in gold content.

As an agitation plant costing considerable money would have been required to leach the slime separately, Mr. Carlisle determined after considerable test work that a 60-40 mixture of sand and slime would give a 96 per cent recovery in eight days' leach, provided the slime was well dried before mixing. He accomplished this by plowing a different section of the slime pond surface to 6-in. depth each day, and letting the sun dry it out until the lumps were hard-baked. Three scrapers full of sand, two of slime, and 2 lb. of lime per ton gave the proper mix for the tanks.

Half a day for filling a new tank, and half a day for emptying a leached tank, four days for leaching and four days for washing, completed a nine-day cycle of operations. The work was done each day in a single shift, from 7 a. m. to 5 p. m., with four men and two horses. Mr. Carlisle supervised, made all the tests, and attended to the monthly clean-up and bullion melt. When the chores were done he gave the men liberty, so that they worked hard, and often were free by 2 p. m.

The plant was designed for 30 tons a day. It was a simple compact affair, consisting of a stock solution tank, a 6 x 4 ft. cement gold solution or regulating tank, a large sump tank, zinc boxes, a pump, and nine new redwood leaching tanks of 30 tons' capacity each. These were 16 ft. in diameter and 5 ft. high, and furnished with filter bottoms by the Pacific Tank & Pipe Company. They were grouped in one row of five and one of four tanks. Between the rows and outside of them were tracks for a dump car, to facilitate the removal of the barren sand. The tanks had no bottom gates and rested on sleepers. Only the zinc boxes and bullion room were housed. The wooden filter bottoms of the leaching tanks were covered with one layer of coco matting, over which were two layers of burlap, protected by wooden lath against the shovels, and caulked with rope around the edge. Distance to the waste dump was 200 ft., and the tanks were also about 200 ft. from the sand and slime. Both water and cyanide solution were fed to the tank surfaces by 1½-in. pipe which connected to the water mains of the Yellow Aster Mining Company and to the stock solution tank. The filter bottoms were connected by a 2-in. pipe to the regulating tank, and thence to the zinc boxes and the sump tank, or bypassed directly to the sump tank. From there the return pump sent the water to the filling line, the regulating gold tank or the stock solution tank, as desired. Suitable valves made flow regulation easy.

Each row of tanks was spanned by an 8-ft. wooden bridge of 2 x 6-in. stringers, spaced 1½ in. apart, and covered with a removable plank top in sections. There was a wooden approach ramp for the loaded scrapers and a tail ramp for the empties; also a stout rail guard on the sides.

One man on the bridge broke up the lumps too big to pass 1½ in., and one man below raked and mixed the material and spread it while it was being dumped, and shoveled in the lime, while two men and the two horses handled the scrapers and did the plowing. The tanks were heaped up, for the contents settled with the wetting. When leached and washed, the barren sand was shoveled into the car and dumped, all hands helping.

There were two rows of zinc boxes, ten in each. They were of standard iron design, fitted with removable trays for the zinc shavings. The rows were used alternately, one being cleaned up while the other was working.

On heads of $7 per ton the tailings assayed 25c. Cyanide consumption was less than half a pound per dry ton of tailing, as there was little copper.

Operating costs, based on 30 tons of sand and slime per day of 24 hr., were:

	Per Day
1 superintendent and chemist @ $200 per month	$ 6.50
2 men @ $4, 2 men @ $3.50	15.00
2 horses @ $1	2.00
Labor insurance, 10 per cent of $15	1.50
Gasoline, oil and incidentals for pump	1.00
60 lb. lime @ $20 a ton delivered	.60
Cyanide, 15 lb. @ 20c.	3.00
Water @ $1 per 1,000 gal. about 10c. ton	3.00
Assay materials, chemicals and incidentals	1.00
Repairs and miscellaneous	1.20
Total per day	$34.20
Total per ton of tailings	1.14

To these costs will have to be added the amortization of the plant cost of $3,500 over three years, as there was no salvage; a small charge for marketing the bullion; and local, state, and federal taxes. There was no royalty, as the work was done for the owners of the tailings. Board and room for the men was provided in the near-by towns of Randsburg and Johannesburg by the men themselves. The bullion shipped varied from $15 to $18 per ounce at the mint, owing to the irregular value of the tailings.

Although this work was done from 1907 to 1910, similar costs will prevail today for an operation of this size, although net recoveries and net profits will be much greater with gold selling at $35 an ounce. Compensation insurance and taxes will be dependent upon local conditions and the varying tax quota of the present time. The difficulty will be to find tailings of such value and character in the United States today, as most piles have been treated. Some are to be had, however, in Mexico and in South America.

Pilot mill of Mineral Recoveries, Inc., north of Webb City, Mo. The manner of disposing of the tailings, by gravity flow into a valley, is unusual for the Tri-state district

Yankee Ingenuity in a Tri-State Mill

The application of nomographic charts in plant work —Time factor in conditioning flotation feeds

C. E. Heinz

Metallurgist

2333 Wall St., Joplin, Mo.

LABORATORY STUDY of the re-treatment of certain old slime-pond materials in the abandoned Webb City-Carterville zinc-mining district, in Missouri, indicated the need of more time for conditioning of the flotation pulp feed than is usually required or given in re-treating Oklahoma-Kansas zinc tailing. The material to be treated contains much soil contamination mixed with the fines that had overflowed from the old-style Joplin sludge tanks or table-feed catch boxes. Recoverable sulphide minerals all pass a standard 200-mesh screen and are badly oxidized on the surface, as much as 20 per cent of the total metallic zinc content of the old slimes being in some oxidized form; that is, soluble in aqua ammonia.

Study of possible means of re-treating these old slimes indicated that a mechanical or chemical conditioning would be essential if metallurgical results were to be better than mediocre. It appeared that a combination of the two procedures would produce the best results. More detailed study of the problems involved bore fruit in the design and building of a pilot or test mill near Webb City. To date this plant has produced and sold more than 500 tons of concentrates at the rate of 60 tons per week when operating full time (24 hours for 7 days). The metallurgical results have surpassed those predicted from the laboratory study.

The time factor in conditioning flotation feeds for the optimum operation of most mills is usually sadly neglected. Perusal of existing literature is proof that the Tri-State district is not alone in ignoring this important matter, if the flowsheets examined are a criterion of modern flotation-mill design.

The test plant of Mineral Recoveries, Inc., at Webb City, incorporated from the start two tanks, called "Pachucas" for want of a better name, in which the flotation feed could be conditioned for better metallurgical results. These have proved satisfactory.

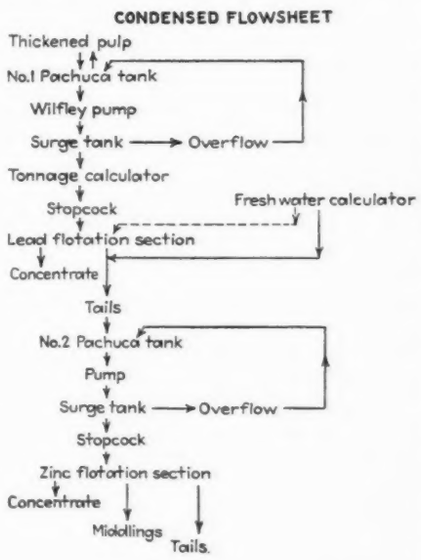


Fig. 1—Flowsheet of the pilot mill of Mineral Recoveries, Inc., where the work described was done

From the economic viewpoint, there is an optimum time factor for conditioning flotation feeds in dealing with almost every flotation problem. These tanks were therefore designed for either continuous flow with surge capacity or for batch operation. Each scheme has been tried and each has merit. However, it appears that the tanks are more useful in this plant when working as continuous conditioners. The principle advantage of the open circuit is that the variable depth of the pulp in the conditioning tank determines the time factor. This feature of these tanks should interest many mill operators.

Construction of the tanks is simple. Two old discarded steel cones, 8 ft. in diameter, were capped with a 6-ft. steel ring, and a discharge pipe was welded in near the bottom to allow the tank to discharge 3,000 gal. of pulp when full. The foot of the cone was set on a concrete form, and the "ears," at four points on the top of the cone, were supported by timbers tied together.

The method of agitating the pulp in the cones was given much thought. Various means of mechanical operation were considered; among them a centrifugal-pump circulator, shown in Fig. 7, was given a trial. This idea was abandoned because of the clogging of the pump when shut down with a full load of pulp; also, the wear on the spider proved greater than anticipated. The "Pachuca" tank, modified for this problem, was then adopted, air under low pressure being used to agitate and mix the pulp, at the same time chemically stabilizing it.

A 40-cu.ft. Curtis air compressor, like the compressors used in large filling stations and garages, was set up to deliver 30 cu.ft., or about 225 gal., of free air per minute. No air receiver was installed, as rather large iron pipe was used to convey the air from the pump to the tanks. The top of a 2-in. pile "T" rests on the top of the tank with the leg of the "T" extending down into the

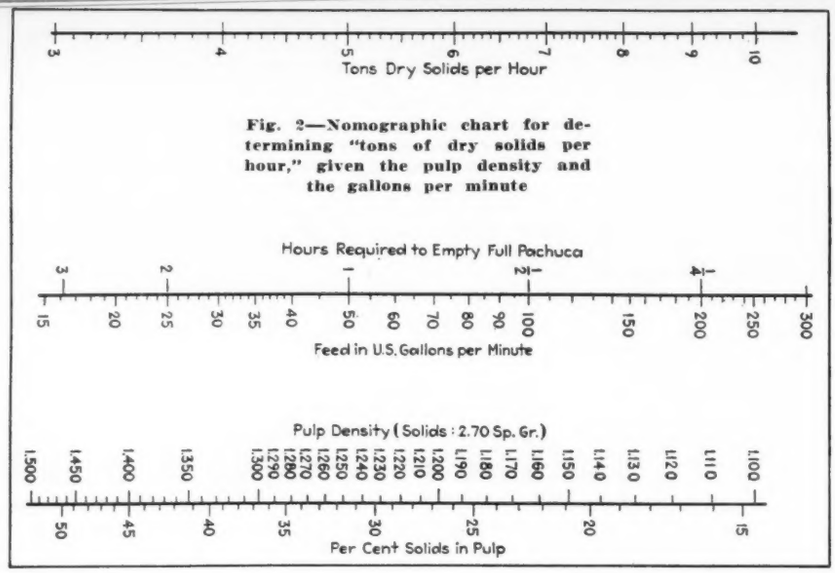

Tons Dry Solids per Hour
Hours Required to Empty Full Pachuca
Feed in U.S. Gallons per Minute
Pulp Density (Solids : 2.70 Sp. Gr.)
Per Cent Solids in Pulp

Fig. 2—Nomographic chart for determining "tons of dry solids per hour," given the pulp density and the gallons per minute

ratio as will give the best results. This arrangement has been found satisfactory in every way. The size of the tanks allows a range of conditioning time from a few minutes to almost one hour for this plant, and the constants required can be maintained with little care on the part of the millmen.

To secure the best operating results, two variable factors, other than the time of conditioning, had to be controlled: the number of gallons per minute of the pulp passing through the tanks, and the pulp density. From the figures representing these variables are calculated the number of tons of dry pulp per hour being treated. In order that this information might be secured by the millmen, accurate but simple means had to

tank to within a few inches of the bottom. The bottom of the leg is covered with a soft rubber sleeve, which is slit to allow the air to pass through and hold out much of the pulp when the air pressure is released.

As the height of the pulp level is varied to meet the time factor desired, for each tank, the air to each tank is controlled through a half-inch globe valve, the total air delivered being divided between the two tanks in such a

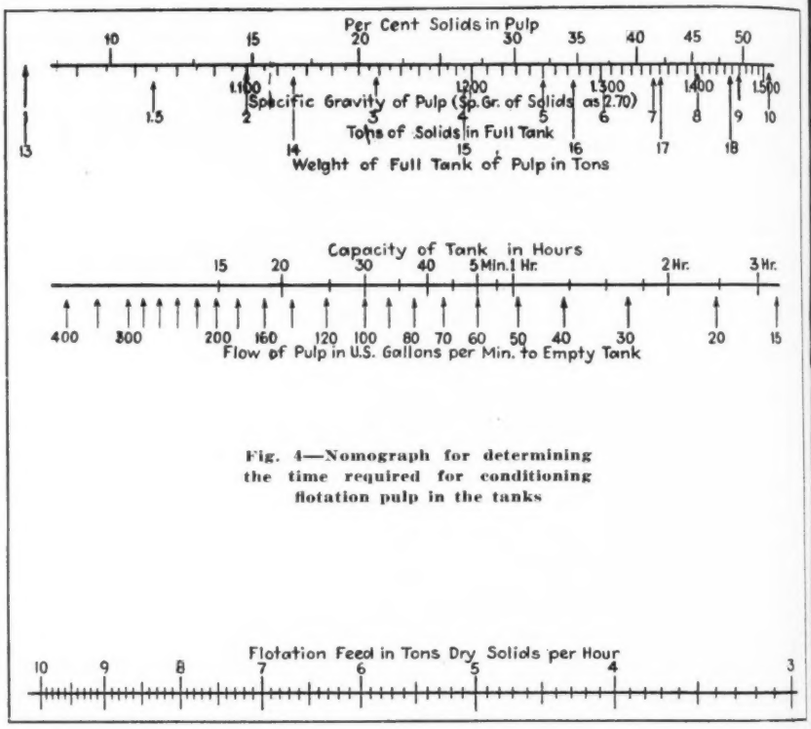
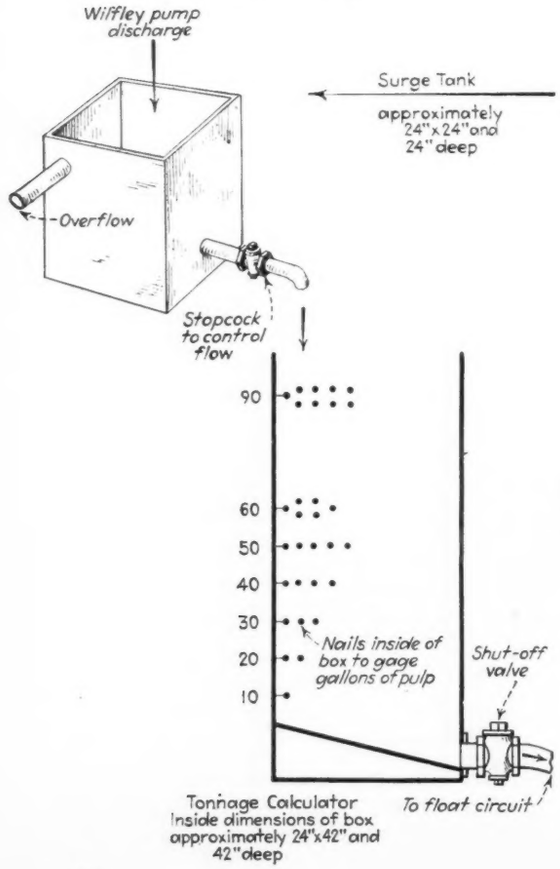

Per Cent Solids in Pulp
Specific Gravity of Pulp (Sp. Gr. of Solids as 2.70)
Tons of Solids in Full Tank
Weight of Full Tank of Pulp in Tons
Capacity of Tank in Hours
Flow of Pulp in U.S. Gallons per Min. to Empty Tank
Flotation Feed in Tons Dry Solids per Hour

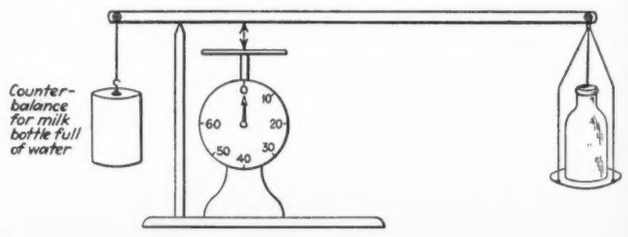
Fig. 4—Nomograph for determining the time required for conditioning flotation pulp in the tanks

Fig. 3—A diagrammatic sketch illustrating the construction of the "tonnage calculator" and the manner of using it



be provided. The first step was to determine the specific gravity of the pulp or the per cent of solids. The mean specific gravity of the dry solids being treated was found to be about 2.70. Standard quart milk bottles are used to sample the pulp. A special compound lever scale was made from odds and ends and a common household 24-lb. spring scale, as sketched in Fig. 5. The milk bottle, full of clear water, when

Fig. 5—This device for calculating density reads "per cent solids by weight in the pulp." It consists essentially of a compound lever scale and an ordinary 24-lb. spring scale



placed on the extended arm, recorded 0 per cent solids on the dial of the scale. Definite prepared pulps of known per cent solids are then placed in the milk bottle and the "weight" is recorded on the dial as "per cent solids." The finished dial would then record "per cent solids" of any pulp sample taken in the mill. Standard quart milk bottles were adopted for this work because they are not fragile and can be readily replaced when broken.

"Tonnage calculators" had been included in the original mill plans, one for determining the flow of pulp to the flotation circuit and another to determine the quantity of clear water required to procure a lower or more desirable density of flotation feed. The construction of these calculators is simple, as shown in Fig. 3, as is also their operation. The pump discharge from a "Pachuca" passes into a surge box that overflows back into the tank from which the pulp is being pumped. A 3-in. plug cock at the bottom of the surge tank controls the quantity of pulp passing into the "tonnage calculator." A quick-acting stopcock near the bottom of the latter is closed while the pulp is flowing into it, and the quantity of pulp is measured in terms of "gallons per minute." Thirty seconds is usually sufficient for this determination. When the lower valve is again opened, the flotation circuit is not disturbed if the test time is less than one minute.

Simple nomographic charts were prepared for the millmen, to simplify the calculations required to determine the number of dry tons solids being treated in one hour. After the millman has determined the density of the prepared flotation pulp in terms of per cent solids, and has measured the flow of pulp to the flotation machines in terms of gallons per minute, he refers to a chart like that in Fig. 2. A string held taut from the density scale through the gallons-per-minute scale reads "tons of dry solids per hour" on the third scale. Should the density of the pulp under examination be greater than he desires, he holds one end of the string on "tons of dry solids per hour" through the "gallon-per-minute scale" to the desired density. The difference between the two readings of "gallons per minute" is very close to the exact amount of water that will have to be added each minute to procure the desired density. The fresh water to be added to the circuit is measured through the "twin" calculator built adjacent to the pulp "tonnage calculator." As noted in practice, the average time required for determining "density" and flow of pulp and for read-

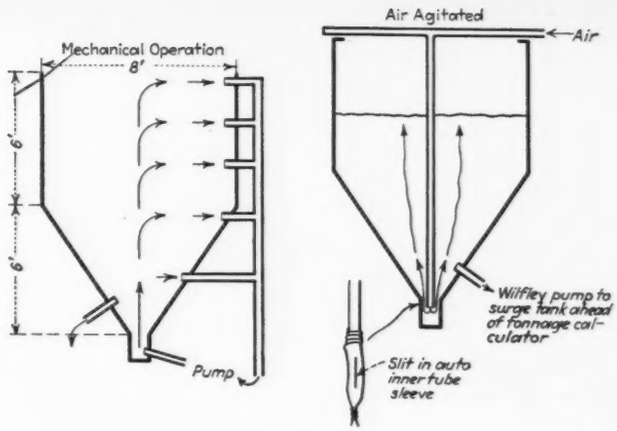


Fig. 7—Sketches showing the arrangement of the conditioning tanks for agitation of the pulp by mechanical means (a pump) and by air, respectively

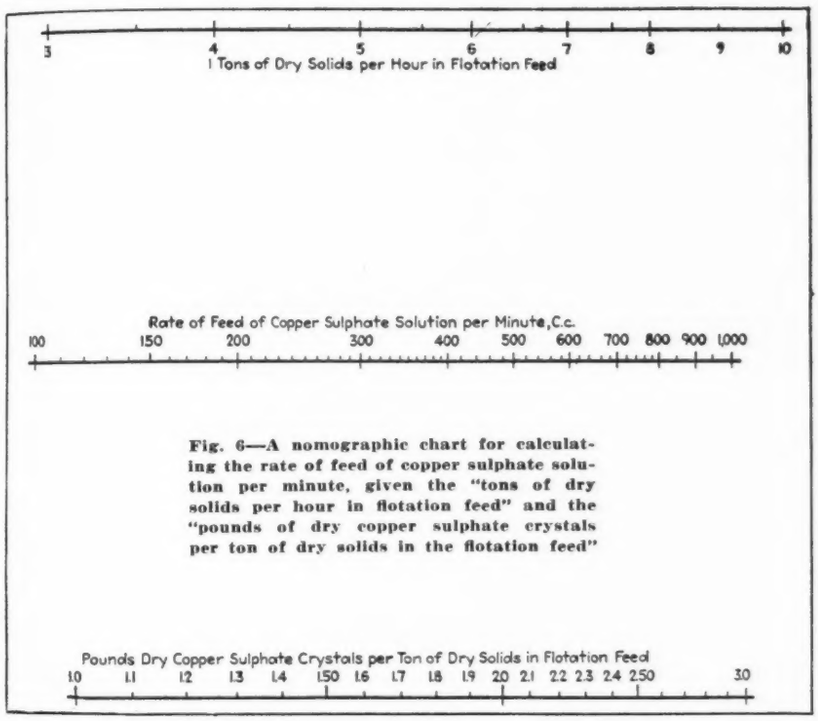

3 4 5 6 7 8 9 10
Tons of Dry Solids per Hour in Flotation Feed
Rate of Feed of Copper Sulphate Solution per Minute, C.c.
100 150 200 300 400 500 600 700 800 900 1,000
Pounds Dry Copper Sulphate Crystals per Ton of Dry Solids in Flotation Feed
1.0 1.1 1.2 1.3 1.4 1.50 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4 2.50 3.0

Fig. 6—A nomographic chart for calculating the rate of feed of copper sulphate solution per minute, given the "tons of dry solids per hour in flotation feed" and the "pounds of dry copper sulphate crystals per ton of dry solids in the flotation feed"

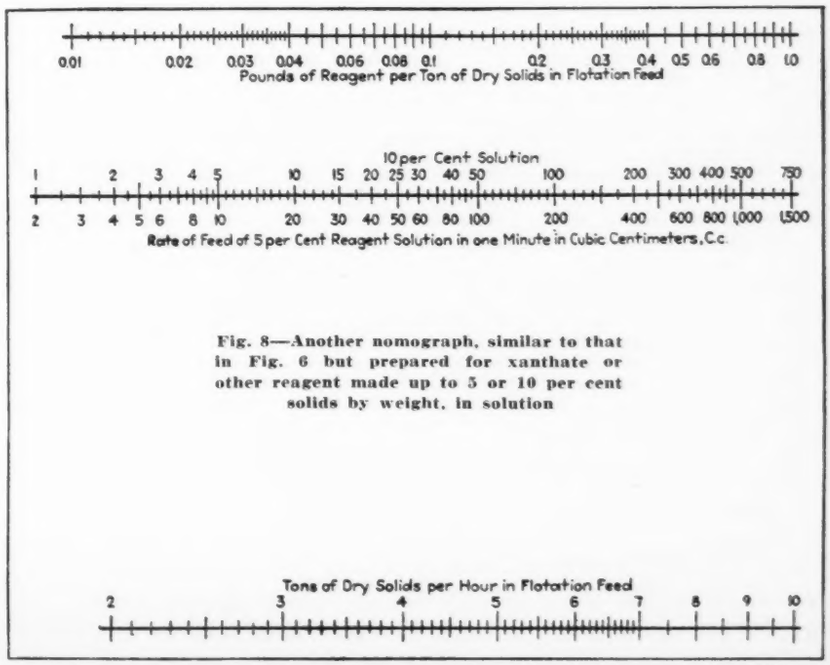

0.01 0.02 0.03 0.04 0.06 0.08 0.1 0.2 0.3 0.4 0.5 0.6 0.8 1.0
Pounds of Reagent per Ton of Dry Solids in Flotation Feed
10 per Cent Solution
1 2 3 4 5 10 15 20 25 30 40 50 100 200 300 400 500 750
2 3 4 5 6 8 10 20 30 40 50 60 80 100 200 400 600 800 1,000 1,500
Rate of Feed of 5 per Cent Reagent Solution in one Minute in Cubic Centimeters, C.c.
Tons of Dry Solids per Hour in Flotation Feed
2 3 4 5 6 7 8 9 10

Fig. 8—Another nomograph, similar to that in Fig. 6 but prepared for xanthate or other reagent made up to 5 or 10 per cent solids by weight, in solution

ing the number of "tons dry solids per hour treated" is about two minutes.

Another chart, Fig. 4, was prepared to assist the millmen to determine the time required for conditioning of the pulp in the "Pachuca" tanks.

The next step in plant control was the rapid determination of reagent consumption or the increase or decrease required in the quantity of reagent in the conditioning tanks or any part of the flotation circuit. A special nomographic chart was prepared for the copper sulphate solution, Fig. 6, the strength being empirically established at 19 per cent solids in solution, by weight. Another chart was prepared for xanthate or other chemical solution, Fig. 8, made to 5 or 10 per cent solids by weight, in solution.

Plant practice has established limits for the quantity of reagents usually found sufficient for best plant results, in terms of "pounds per dry ton pulp." These charts have proved to be of notable value in this experimental mill, as they have assisted greatly in overcoming the normal tendency of almost all flotation men to use more reagent than is required.

In practice, the flotation operators measure, by means of a graduated glass cylinder, the number of cubic centimeters of reagent solution flowing into the flotation circuit. The time required is either 30 sec. or one minute, and the reading is recorded as "c.c. per minute." Knowing the number of "dry tons pulp" being treated in one hour, from the previous chart readings, the operator holds his string taut across the special chart and reads direct the "number of pounds of reagent used for 1 ton of dry pulp." Knowing the limits established in this plant for reagent consumption, he knows exactly how much to increase or decrease the reagent under observation, by direct reading from the chart, the quantity of reagent being increased or decreased, in terms of "c.c. per minute."

This plant has proved that practical millmen can and will do better work if and provided they are given simplified ways and means of measuring some of the many variables found in all mills.

One can see from the preceding paragraphs that this experimental plant is rather flexible in operation. The lead machine feed is conditioned by measured chemical and time control, and the tailings from this circuit can be conditioned and prepared for the zinc circuit in a like manner.

All readings are recorded, the time is given, and the changes made are checked and recorded also. These data, recorded by the millmen, have proved very useful in studying this milling project, and analyses of the finds should materially reduce errors in mill operation in the future.

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Sugarloaf Butte

Robert E. S. Heineman

Mineralogist, Arizona Bureau of Mines
Tucson, Ariz.

Character of Arizona deposit resembles that of Marysvale, Utah, but carries more alumina and much less silica—The soda content is high, with potash correspondingly low

IN THE latter part of 1929, and later in 1930, mineral samples which were submitted to the Arizona Bureau of Mines for identification were classified as alunite. Upon investigation,[1] the deposit from which the samples came was found to be located in central Yuma County, Ariz., about 5 miles west of Quartzsite[2] and 1 mile south of United States Highway 60. It is, as the crow flies, about 11 miles east of the Colorado River, about 175 miles from Boulder Dam, and 19 miles from Blythe, Calif. In 1931, more samples were submitted by Ropp Brothers, of Quartzsite. Ropp Brothers are the owners of five claims, which include the deposit. Eldred D. Wilson, geologist of the Arizona Bureau of Mines, visited the deposit in 1931 and furnished me with the data that are given in this paper concerning the field relations.

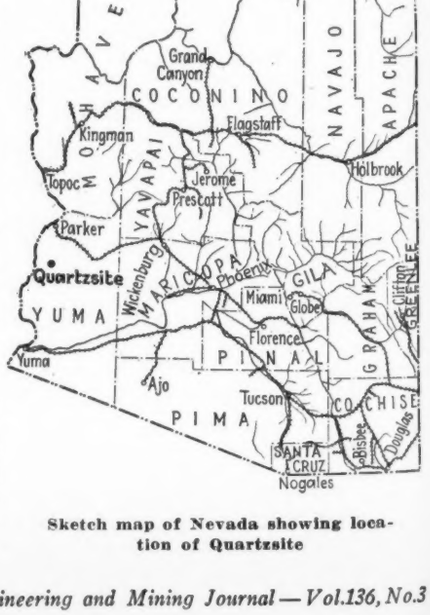
The deposit is situated in the northwest base of a dark-colored butte, known locally as Sugarloaf. This butte rises prominently from an irregular, erosion-cut, white rock surface near the eastern margin of the Dome Rock Mountains, which have been described briefly by Bancroft,[3] Jones,[4] Ross,[5] and Darton.[6]

Wilson's field examination shows the light-colored rocks to be schists of well-developed, rather flat-dipping fissility. As seen in thin section, this material is a very fine-grained quartz-sericite schist with an evenly foliated texture except for the presence of small, scattered, angular "augen" of primary quartz. A small amount of late silicification may be also noted.

Sugarloaf Butte, which is a few hundred feet high and about an eighth of a mile across, is called a latite plug by Ross in the title of a photograph,[7] but the cap rock as shown in a thin-section is a fine-grained quartzite. It is a pale, buff-colored, finely textured rock with a few angular grains of quartz averaging about $\frac{1}{8}$ in. in size scattered throughout a typical quartzite matrix.

The base of the butte, which includes the alunite deposit, is a dacite. The alunite occurs as branching, irregular veins within this rock. In 1931, good exposures of the veins were provided by a 200-ft. tunnel and several open cuts. Generally, the veins are from a fraction of an inch to a few inches wide, but in places they are a foot or more across. They appear to constitute about 10 per cent by volume of the rock exposed by the workings, but do not seem to be uniformly pure. Some vein quartz, apparently older than the alunite, and a little superficial gypsum were noted by Wilson. Ropp Brothers say[8] that since Wilson's visit considerably more ore has been uncovered.

The dacite has a pink appearance where exposed on the surface, but becomes lighter in color adjacent to the veins. This color is caused by reddish



Sketch map of Nevada showing location of Quartzsite

Alunite

Sugarloaf butte with tunnel dump in foreground. Photograph by Eldred D. Wilson.

hematite and is evidently significant of the oxidized zone. Several specimens of dacite taken in the tunnel are white in color, and small specks and grains of pyrite are rather abundant. No hematite is present in this material, but hardly any pyrite can be noted in the pink phase. The line of demarcation, as noted in several specimens which were composed of both phases, is extremely sharp. In a hand specimen, the appearance is that of two different rocks in contact, but thin-sections show the two to be fundamentally the same rock. And in a hand specimen, the rock, both hematitic and pyritic, has a porphyritic texture without any hint as to whether it is extrusive or intrusive. The rock in thin section is seen to be composed of phenocrysts of primary quartz and acid andesine in a finely foliated ground mass of fine-grained quartz and probably kaolin, with a little sericite and some alunite. Some later, more coarsely grained secondary quartz is present in places in the ground mass. Phenocrysts of primary quartz show marked corrosion and resorption. The plagioclase is fairly fresh, only a small amount of incipient alteration being noticed. The pyrite is chiefly present as small grains in the ground mass, rather than replacing the plagioclase, but, in the hematitic phase, the hematite occurs in and adjacent to fractures in the feldspar and shows a distinct preference to replace feldspar rather than ground mass. Chemical tests show some sulphate sulphur in the pink phase, but not enough to account for more than a little alunite.

As the veins are approached, the rock becomes lighter in color as the amount of hematite decreases. The feldspar then becomes less in amount, whereas the primary quartz remains about constant. An increase takes place in fine-grained material and in secondary silica. Chemical tests of this material show considerable sulphate sulphur, and no pyrite can be seen. Evidently, then, considerable alunitization of the wall rock exists adjacent to the veins, and a small amount at a greater distance.

The vein alunite is generally white in color and massive in form, being fine-grained with a porcelain-like appearance, and breaking with a conchoidal fracture. No coarsely crystalline alunite was noted. Under the microscope, it is seen to be microcrystalline and shows a distinct textural banding. Small grains and stringers of secondary quartz are present. These stringers follow the banding. Near the margins of the veins, the alunite contains angular fragments of what, macroscopically, appear to be included particles of wall rock, but microscopic examination shows these particles to be composed almost entirely of hematite. As hematite also is found in the wall rock, evidently a relation exists between the two, probably of minor importance. The veins, in my belief, are fissure veins, rather than replacements of the wall rock. The situation is quite similar to the Marysvale, Utah, alunite deposits, where the veins are said by Butler[9] to be fissure fillings. The veins both at Marysvale and at Sugarloaf Butte show distinct banding typical of fissure veins, and the quartz phenocrysts, which remain constant in amount through the country rock, are absent from the veins. These quartz phenocrysts are abundant in the bordering alunitized wall rock, and if the veins had been replacements of the wall rock they should also occur in the veins. That silica which is present in the veins is distinctly a late quartz.

Partial analyses of Sugarloaf Butte alunite were made in 1931 and in December, 1934. The earlier sample was a grab specimen. The recent analysis was made on a large sample of high-grade vein material. These analyses[10] are presented in the accompanying table and may be compared with an analysis of typical Marysvale alunite which is also given.[11]

Analyses of Alunite Samples, in Percentages

Sugarloaf (1931)		*Marysvale*	
Al_2O_3	35.19	Al_2O_3	34.04
K_2O	9.70	Fe_2O_3	trace
SiO_2	7.44	SO_3	36.54
Sugarloaf (1934)		P_2O_5	0.50
Al_2O_3	36.5	K_2O	9.71
SO_3	38.1	Na_2O	0.56
K_2O	4.85	H_2O+	13.08
Na_2O	4.3	H_2O-	0.11
SiO_2	1.2	SiO_2	5.28

As indicated in the table, Arizona material analyzed recently carries about 2 per cent more alumina and much less silica than the Utah alunite. On the other hand, the Arizona sample carries considerable soda and correspondingly less potash. During the War the primary interest in alunite was for its potash content, but now aluminum is the chief element sought, so the high soda should not be detrimental. The low silica should be a distinct advantage.

More field work will be required to determine the structure of the area, to show the relations between the dacite and the schists, and to judge the actual extent of the orebody. Preliminary work shows that dacite, whether extrusive or intrusive to be determined, is cut by branching fissure veins of alunite. The reddish portion of the dacite is evidently the weathered and oxidized surface rock.

This deposit is similar to that of Marysvale, inasmuch as the same general type of veins occur in a similar host rock and the alunite itself is like the porcelaneous portion of the Marysvale alunite.

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[1]Personal communication from Morgan Jones, of Kingman, Ariz.

[2]Quartzsite is a small mining community, and the name means "site of quartz," rather than a corruption of the rock term, quartzite.

[3]Bancroft, Howland: Reconnaissance of the Ore Deposits in Northern Yuma County, Ariz.: U. S. Geological Survey Bull. 451, 1911.

[4]Jones, E. L. Jr.: "Gold Deposits Near Quartzsite, Ariz." U. S. Geological Survey Bull. 620, pp. 47-57, 1916.

[5]Ross, C. P.: "The Geology of the Lower Gila Region, Ariz." U. S. Geological Survey Professional Paper 129, pp. 183-197; 1922.

[6]Darton, N. H.: "A Résumé of Arizona Geology." Arizona Bureau of Mines Bull. 119, pp. 219-221, 1925.

[7]Ross, C. P. *Op. cit.*, Plate XLII-A.

[8]Written communication.

[9]Butler, B. S., and Gale, H. S.: "Alunite—a Newly Discovered Deposit Near Marysvale, Utah." U. S. Geological Survey Bull. 511, p. 7, 1912.

[10]Analyses published with the permission of Ropp Bros. The 1931 analysis is by W. A. Sloan; the 1934 analysis by F. S. Wartman.

[11]Butler, B. S., and Gale, H. S.: *Op. cit.* p. 8, sample No. 19.

NEWS OF THE INDUSTRY

Phelps Dodge Corporation Acquires Control of United Verde

Now the Second Largest Copper Producer in United States—Net Profit of Sunshine Mining Last Year $1,208,195, With Total Cost of 29.2 Cents per Ounce of Silver Produced—International Smelting Reopens Its Miami Plant

ACQUISITION of a controlling interest in the United Verde Copper Company by the Phelps Dodge Corporation was the outstanding development in the mining industry of the United States during the past month. By virtue of this increase in its holdings, Phelps Dodge becomes the second largest domestic copper producer—that is, on a capacity basis—being exceeded by only the Kennecott Copper Corporation, which has a domestic annual capacity, according to the Copper Code, of 366,500 tons. Phelps-Dodge, with its former capacity of 168,000 tons and United Verde's capacity of 68,000 tons, now has a total capacity of 236,000 tons, topping by a slight margin the 225,000-ton capacity of the Anaconda Copper Mining Company. Announcement of the new control of United Verde was made at the annual meeting of the company, held in New York on Feb. 13. At the meeting four officials of the Phelps Dodge Corporation—Louis S. Cates, president, Cleveland E. Dodge and James F. McClelland, vice-presidents, and H. DeWitt Smith, director—were elected directors. Following the meeting Mr. Cates was made president of United Verde and Mr. Dodge vice-president.

Stockholders of the Sunshine Mining Company, the country's leading silver producer, were informed by Frank Eichelberger, vice-president, in the course of the company's annual meeting, held at Yakima, Wash., on Feb. 13, that during 1934 the company milled 108,605 dry tons of ore, producing 3,697,916 oz. of silver. Net profit, after income tax, depletion, and depreciation, was $1,208,195.97. Total cost per ounce of silver produced, including income tax, was 29.2c. Another significant statement made by Mr. Eichelberger was that "the value of the ore, as well as the width of the vein, has shown a definite and steady increase with depth."

International Smelting announced that its smelter at Miami, Ariz., would be opened this month. Operations at the plant were suspended three years ago. About 100 men will be given employment by the resumption of operations.

A summary follows of the more important news events that occurred in the various mining areas during February.

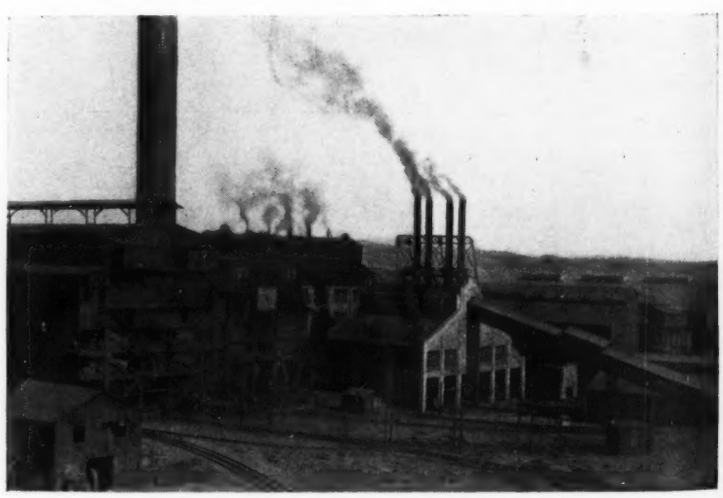
CALIFORNIA

• According to reports received from Mojave, Golden Queen Mining, subsidiary of American Gold Fields, plans early erection of a 250-ton mill at the Golden Queen mine, formerly known as the Silver Queen, on Soledad Mountain. Preliminary clean-up work under way at the mine is said to have engaged about 30 men, which number will be increased as development and mining of ore progresses. Charles Kumke, superintendent, is in charge of operations.

Erection of a 180-ton cyanide mill at the Red Cross mine, at Dobbins, is advancing satisfactorily under the direction of Fletcher Hamilton, former State Mineralogist of California, who is in charge of the Red Cross enterprise.

Development of the new vein of gold ore discovered some weeks ago during horizontal drilling operations on the 1,600-ft. level at American Gold Fields' Union mine, near Eldorado, is progressing rapidly. The vein, said to be about 20 ft. wide, constitutes one of the largest low-grade orebodies found in the Eldorado district in recent years. About 60 men are employed at the mine under the direction of J. T. Boyd, manager.

Work on the new 16-cu.ft. gold placer dredge of Natomas Company, under construction in the Salsbury district, between Mills and Alder Creek, is progressing satisfactorily. The dredge, to



• Copper smelter of United Verde at Clarkdale, Ariz. This plant, an important unit of the extensive works acquired by Phelps Dodge, was placed in operation in 1915. Numerous additions made since its erection have built up the smelter's daily capacity to about 5,000 tons of ore and concentrate. Only one furnace is in operation at present; this is being charged with siliceous ore that contains considerable gold and silver, mined on the lower levels of the United Verde property

be placed in operation some time this month, is of all-steel construction, and many new features are embodied in its design. These include a direct-driven bucket line, exclusive use of speed-reducer units in place of belt drives, and automatically controlled machinery. Practically all motors on the dredge are driven by direct current, the motor generator set and main switchboard being installed in the hull of the dredge. The steel hull measures 114x54x11ft.; the digging ladder is 95 ft. long from center to center; the two stackers are 95 ft. long; and the trommel is 9 ft. in diameter, with a screen section 36 ft. long. The capacity of the dredge is 350,000 cu.yd. a month, and its cost will be about $400,000. The digging depth, averaging 36 ft., is shallow when compared with some of the other dredges in the field. R. G. Smith is general manager of the dredging division of Natomas Company.

Rehabilitation of the Old Presscott Hill mine, near the Empire mine, at Grass Valley, is reported to be progressing steadily. Empire-Star Mines, owners of the property, have equipped the mine with a new headframe and hoisting machinery, and the shaft is said to be cleared and unwatered to a depth of 200 ft. The mine was a noted gold producer about 40 years ago.

The Argonaut mine, at Jackson, and the Original Amador mine, at Amador City, were reopened on Feb. 13, despite prevailing strike conditions. The limited number of men employed at the mines at the present time will be increased gradually after preliminary work and unwatering operations have been completed.

MICHIGAN

• Water in the Ropes gold mine, near Ishpeming, which is being reopened by Calumet & Hecla Consolidated Copper, has been lowered below the fourth level, a depth of more than 200 ft. A large pump will be installed to remove the water from the rest of the shaft. The mine has fifteen levels that extend to a depth of 850 ft. Estimates are that pumping until April 1 will be required to unwater the mine. Miners are putting in a new ladderway and repairing the shaft as the water level recedes. A hoist and compressor will soon be installed. A crew of 25 men is employed, and this force will be increased as needed. A "dry" and boiler house are being erected near the shaft. Considerable equipment has been shipped to the property and it will be in readiness by the time the mine is free of water. In addition to the two "forties" known as the Ropes property, Calumet & Hecla has under option ten "forties" to the west of the Ropes area, and this second tract will also be explored. The Ropes ground will be thoroughly investigated both at depth and laterally. Geology of the area is considered favorable, and modern methods are being counted on to extract the free gold in the quartz at a minimum cost.

Agitation to retain protection for the domestic copper industry has been started in the Michigan district and several organizations have adopted resolutions, to be sent to Washington, urging the enactment of such legislation as may be necessary effectively to prohibit the importation of any foreign-produced raw or refined copper for consumption in this country. The temporary protection provided under the revenue bill will expire in June this year. The Michigan district is joining with Arizona and other copper-producing states in a vigorous campaign to insure an adequate import levy after the expiration of the present provision.

UTAH

• Attention in the east Park City district is centered on the development of the Wasatch limestone, below the Weber quartzite. Park City Utah Mining's opening up of an orebody in this horizon has stimulated new interest in the possibilities of this formation. At present, Park City Utah Mining is shipping ore from development that carries a quantity of gold, a unique occurrence in the history of this camp, which has been famous in the past for its production of lead and silver. Drifting and raising are being done on the orebody for the purpose of finding out more about its size, strike, and dip.

Adjoining this property, New Park Mining is drifting and raising to prospect the contact of the Wasatch limestone and the Weber quartzite, already opened up in three places at points embracing a distance of two miles. Geologic conditions in the Mayflower tunnel are reported to be similar to those surrounding the deposit struck in the Park City Utah Mining property in a drift from the Star of Utah tunnel.

New Park Mining recently placed the Marsac and Epperson claims under bond and lease to Park City Development. Charles Moore has a crew of miners opening up the old workings in the Flagstaff group of claims of New Park Mining.

Two winzes are being sunk below the 1,100 level in the property of Park City Development, under the direction of L. Hurley, manager. As the sulphide zone is entered, Mr. Hurley reports that considerable improvement in the grade of ore is being noted. To the east of the American Flag shaft, a fissure is being followed that carries good ore. Between the 900 and the 1,100 levels, leasers are taking out ore for shipment. Two carloads of this ore, Mr. Hurley reports, brought $50 a ton at the smelter. Leasers on the 1,100 level are said to be taking out considerable ore of good grade.

The plant of the Utah State Road Commission, 7 miles west of Vernal, has started operations for the purpose of mining asphalt for paving. A new pug mill for mixing the asphalt has been added, as well as a compressor, a 4,000-gal. storage tank, an 85-hp. steam engine, and a boiler providing 125-hp. additional capacity. An electric-light plant is to be installed to provide light for the night shift. More than 7,000 tons of asphalt is to be mined. A high-grade product is mined, crushed, and mixed with a lower-grade product to make it suitable for road-building material.

United States Smelting, Refining & Mining shut down its lead refinery at Midvale on Feb. 1. About 100 men were thrown out of employment by the shutdown. Operations of the mill and smelter have not been affected. Bullion is being shipped to the company's East Chicago plant. According to E. A. Hamilton, general manager, the plant may be reopened this summer. The date of reopening will be influenced by the condition of the lead market. During the suspension of operations, the company expects to conduct experimental work on methods to improve metallurgical processes.

George H. Watson, manager of the Alta Champion property, in Little Cottonwood canyon, 25 miles southeast of Salt Lake City, reports that development work has opened up streaks of high-grade ore in the Wedge and Boston fissures. During the year just closed, the company reopened its Dwyer tunnel for a distance of 3,000 ft., in addition to building ore bins, a blacksmith and compressor house, and snowsheds.

KAN.-OKLA.-MO.

•Treating a mixed feed of mine ore and tailing, a practice that has never been successful in the past, is being accomplished economically by Skelton Lead & Zinc and Lawyers Lead & Zinc, in the Tri-State zinc and lead district. The practice has two distinct advantages to the two companies. In the instance of the Skelton property, which is nearly depleted, it allowed the company to continue operating its concentrator at capacity 24 hours a day when it was becoming increasingiy difficult to furnish sufficient mine ore to keep the plant operating on a single ten-hour shift per day. In the instance of the Lawyers mine, combining of the tailing and mine ore feed has allowed the company to continue doing a large amount of underground development work while treating the rich tailing on the property.

The Skelton mill is treating about 7½ tons of mine ore per hour with about 50 tons of tailing. Feed from the mine ore hopper and the feed from the tailing hopper are run to the first dirt eleva-

tor, where they are sufficiently mixed to be treated without material loss on the rougher jigs. The main problem that the Skelton company encountered was in keeping its mine ore fairly uniform and not too rich, according to Paul Childress, manager of the plant. A rich mine feed was used at first, and the tailing losses were fairly high, owing to the fact that in the treatment of tailing the feed to the ordinary Joplin type rougher jig of six or seven cells is made in the center of the jig, which gives the effect of two three-cell jigs. With too rich a feed of mine ore the three cells would not catch all of the valuable mineral.

The Lawyers property started on a feed of the same mixture as at the Skelton, but found tailing on some of the old dumps so rich that the tailing feed had to be reduced to about 35 tons per hour. Even then the tailing losses were excessive, owing to an excessive amount of sand in the old dumps. The Lawyers, according to George W. Pearson, manager of the company, expects to avoid these losses by mixing the tailing feed from the old Missouri Mule tailing, which is coarse and which averages a little better than 3 per cent zinc, with the old Fort Worth tailing, which is high in sands and averages from 5 to 7 per cent zinc.

Charles A. Neal, of Miami, has taken a 60-day drilling option on the 80-acre lease of P. J. Dines Mining, in the Picher district. Two drill rigs are being operated on the property. The Dines mill has been producing about 200 tons of zinc concentrate a week.

Frank Childress and Associates have installed a second 14-in. Pomona pump in the Oronogo bottoms, in the Missouri section of the old field, and are pumping about 8,500 gal. per minute. The water, which was practically at the top of the shafts, has been lowered more than 15 ft. since the second pump was installed on Feb. 16. Expectations are that this old district will be unwatered within the next three or four monhs. Several drill rigs are being operated in the Oronogo section by Mr. Childress. The development program will be augmented by underground work once the ground is unwatered.

NEVADA

• Surveys and preliminary sampling have been in progress on 2,000 acres of ground under option to Natomas Company and situated in Manhattan Gulch, Nye County. Much alluvial gold has been taken from the area by placer miners and lessees, and Natomas has announced that, if sampling warrants, it will operate one or more gold dredges on the ground, securing water from wells and springs near the camp.

Completion and successful operation of a new 100-ton cyanide mill by Ohio Mines at Goldpoint, 35 miles south of Goldfield in the old Hornsilver district, is reported. The mill serves the Orleans and Great Western mines, merged several years ago and both former producers of gold-silver ore. The power plant consists of two 200-hp. Atlas diesel engines, direct-connected to 270-kva. generators. Mill equipment includes a gyratory crusher, a ball mill, and two tube mills that grind to minus 165 mesh. Sampling was said to indicate a substantial blocked tonnage of ore which has been developed to a depth of 700 ft. Sydney Harris is superintendent, and Dr. Otto Dieckman, of Cincinnati, now at the mine, is president.

Treating 600 tons per day of accumulated tailing from the old Desert cyanide mill of Tonopah Mining, at Millers, 15 miles west of Tonopah, the plant of General Metals Recovery, under the direction of Albert Silver, is said to have produced $62,141 since late September, yielding 647.1 oz. gold and 48,293 oz. silver from 42,928 tons of ore. To the original sand-treatment plant, a slime plant is soon to be added.

Following the addition of settling tanks, the lately completed 50-ton cyanide mill of Hartford Mining, at Silver City, is reported to be giving satisfactory results, and, with the coming of more settled weather, indications are that capacity will be increased to 100 tons. The Hartford mine, one of the early producers of the Comstock district, is reputed to have a large tonnage of blocked ore of good mill grade. New York and San Francisco men have provided funds for the enterprise, and George Drysdale, veteran Comstock mine manager, is in charge.

Preparations are well advanced for the seasonal reopening of the tailing leaching plant of Bradshaw, Inc., treating tailing from the dismantled 100-stamp cyanide mill of Goldfield Consolidated Mines at Goldfield. When closed down for the winter, the plant was reported to be treating 1,400 tons per day. A late report gave a gross recovery for last year of $209,761 in gold and silver from 359,000 tons of tailing treated during the 285 days of operation. The plant was closed down for the winter on Dec. 15, more than a month later than usual.

Intense heat and hot water have continued to retard work of Pardners Mines, holding an option on the Dixie Valley mine of Comstock Keystone, situated in Churchill County. A 40-ton mill built by the Comstock Keystone has continued running on ore from the first prospect tunnel, which is said to show a great width of ore, including about 12 ft. of high-grade. Pardners Mines, under the management of Charles Mayotte, sank a 100-ft. vertical shaft near the hanging wall, and, when a crosscut at the 100-ft. level entered the vein, the miners were driven out by a flow of hot water. A number of hot springs may be seen along the slope of the low range.

Piermont Mines, with properties in the Shell Creek range and west of Ely, White Pine County, has resumed mining and milling, following a shutdown of more than three years. At the Shell Creek mine, the 50-ton Minerals Separation flotation mill has been reconditioned and has started crushing ore from dumps and storage bins. Power is supplied by a 200-hp. diesel plant. The Piermont mine, first opened in 1869, is credited with an output of several millions in silver and gold.

Construction of a 40-ton mill using amalgamation and flotation was reported near completion on the property of Keystone Mining, southern Clark County, near the California border. The Keystone mine is one of the oldest producers in southern Nevada and adjoins the Chiquita property, in which a large tonnage of high-grade mill ore is said to have been developed in the past year.

Lessees working in ground of Nevada State Mines, embracing the once-productive Seven Troughs mines in Pershing County, have been supplying a substantial tonnage of highly profitable ore to the company mill. Some ore of exceedingly high grade, mined by the lessees, has been sacked and shipped to a smelter in Utah. Interest has centered lately in a discovery of rich ore by lessees in an unexplored area between the Florence and Fairview workings.

Egan Mines, which was organized lately to acquire the old Egan mine, near Cherry Creek, northern White Pine County, closed down for nearly two years, is said to be providing complete equipment, including an 80-hp. diesel engine, generator, electric hoist, and pump, for the purpose of reopening the mine to deep levels. Boston men are said to have backed the project. Roy H. Elliott, a San Francisco engineer, is in charge at the property.

IDAHO

• Directors of Hecla Mining passed the dividend for the present quarter. The Hecla company is making a considerable outlay in the development of the Polaris mine, in the silver belt, and operating the Hecla mine, at Burke, on a curtailed basis owing to the low price of lead and zinc.

The Sherman mine was entirely idle during the past year, stockholders were informed at the annual meeting held in Wallace. The property was kept in first-class condition and awaits only a favorable market for lead and silver to resume operations, the management reported. The treasurer's report showed $56,347.04 on hand.

The footwall seam at the Metropolitan property, on Big Creek, has widened from 2 in. at the tunnel level to about 8 in. in the shaft, according to reports from the mine. The shaft follows the footwall side of the ledge, which is more than 7 ft. wide. Several streaks of

gray copper, carrying considerable silver, have been disclosed in the vein, together with siderite and quartz mixed with the ore. Much of the material taken from the shaft could be classed as a good milling product. Satisfactory progress is being made with the work in spite of recent handicaps occasioned by the deep snow, which retarded transportation for several days. R. S. Merriam, manager, reports that the new equipment is working efficiently, and that he will continue with a systematic development of the vein at greater depth.

Plans for an early resumption of development operations at the property of Gem State Mining are under way, according to W. E. Horstkotte, of Spokane, president of the corporation, who recently spent a week at the claims. The company owns a group of 8 patented and 12 unpatented claims, a short distance west of Mullan, on which considerable development work has been accomplished. The No. 4 tunnel, lowest working section of the mine, has been extended 1,878 ft. New work will include a continuation of this crosscut toward the vein disclosed in the upper levels.

Diamond-drill operations at the property of Coeur d' Alene Mines, better known as Mineral Point, will be under way within a few days, according to reports from the property. The drills are at the No. 3½ tunnel, where the first work will be carried out to prospect the ore resources on this level thoroughly, as it is the scene of recent important disclosures. Later the drills will be used in the No. 5 tunnel, and the wide vein system and its ore contents proved on that level. In the No. 3½ tunnel, the drills will be used for probably 1,500 ft. of exploration, and, in the No. 5, plans are to check the cores from about 2,500 ft. of exploration, according to R. W. Nuzum, president of the company.

At the annual meeting of Sunshine Mining, held at the offices of the company in Yakima, Wash., on Feb. 13, Vice-president Eichelberger stated that during 1934 the company milled 108,605 dry tons of ore, producing 3,697,916 oz. of silver. Net profit for the year, after income tax, depletion, and depreciation, was $1,208,195.97. Total cost per ounce, including the income tax, was 29.2c.

Continuing his report Mr. Eichelberger said: "During 1935 the tonnage mined and milled will probably not be increased materially, but the head assay values will be greatly increased. Since the new mill will be operating in its entirety this month, it is hoped to bring the total ounces of silver produced to 5,000,000 this year at no increase in costs of mining and milling, and to decrease smelting cost as a result of a new smelting contract which was made on Nov. 1, 1934. Costs per ounce should be lower by 10 per cent during 1935."

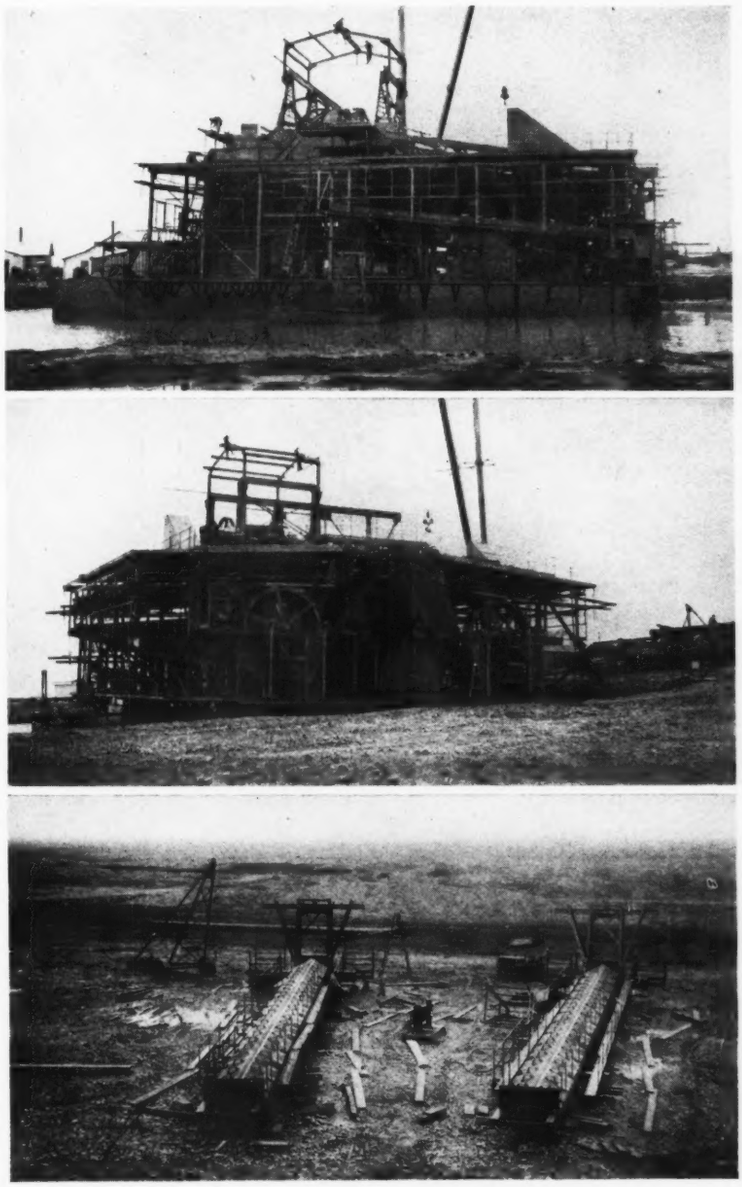
Coeur d'Alene Nellie property is undergoing a deep development program designed to disclose the silver-bearing vein system below the upper tunnel and the shaft operations.

Merger Mines' Aetna group is preparing for a development program that will show the possibilities of the vein system crossing this property. New buildings have been completed and equipment has been made ready for operations.

The Elgin & Ogden group, lately taken over by an Eastern syndicate headed by J. R. Foster, reports that plans are under way to sink 500 ft. to explore four veins exposed by crosscuts on the property.

Lucky Boy, a new property, has excellent ore showing in a more remote section but which may ultimately widen the boundaries of the silver belt by several miles.

• New Natomas Dredge Nearing Completion At Salsbury, California



• This 16-cu.ft. gold placer dredge of the Natomas Company is scheduled to be commissioned next month. Capacity of the dredge is 350,000 cu.yd. per month; digging depth is 36 ft. Special features include direct-driven bucket line and twin-stacker arrangement. At the top—Hull and superstructure. Center—Stacker end of dredge, showing tables and tailing elevator wheels. Bottom—Completed 95-ft. stackers

Sunshine Consolidated, a merger of several well-known Big Creek properties adjoining the Sunshine on the west, will be the scene of some interesting developments during coming months.

MONTANA

• Basin Montana Tunnel, operating the Comet and Grey Eagle mines, east of Basin, Jefferson County, showed a substantial operating profit in January, according to Frank McPherson, superintendent. Lead concentrates are running high in silver and returning the company about $6,000 per car. William H. Hax, New York, president of the company, is making regular monthly visits to the property, traveling by plane from the East.

Little Ben Mining, the largest producer of gold in Montana, is paying a dividend of 4 per cent this month. The property is situated near Landusky, Phillips County. Ore is crushed to about ¼ mesh and leached with cyanide solution. P. V. Wickham is in charge of operations. Morning Glory Mining, operating a silver mine near Basin, Jefferson County, recently shipped two cars of high-grade ore.

Roy Miller, Inc., has sold its interest in the Jib group, at Basin, to a syndicate from Seattle and Portland. Operations will soon be resumed at the property, which in six months in 1924 produced more than $800,000 in gold.

Butte Highlands Mining, operating 18 miles south of Butte, has opened some rich gold ore. The flotation concentrator is operating close to capacity, producing concentrate containing as much as 50 oz. of gold per ton.

Fairview Syndicate is actively operating the Fairview group, in Madison County, and has blocked out about $50,000 of gold ore.

Basin Goldfields, operating in the Pole Mountain district, about a mile northwest of Basin, Jefferson County, has resumed work on its lower, or mill-level, tunnel, which is about 750 ft. east of and 250 ft. lower in elevation than its present main tunnel. The company is storing its high-grade ore until early in March, when a carload will be shipped.

An Eastern syndicate has become interested in the Atlantic & Pacific group, near Pony, Madison County, according to Milton I. Leydig, of Helena, and Charles Whitcomb, of Zortman, who hold an option on the group. The property is opened by several cuts and tunnels on a vein that is more than 50 ft. wide. Shipments made to the Washoe smelter in 1934, in carload lots, assayed better than $12 per ton in gold.

The Mining Association of Montana held a large "legislative" meeting in Helena on Feb. 12, Carl J. Trauerman, of Butte, presiding. Among those addressing the meeting were Dr. Francis A. Thomson, president of the Montana School of Mines and head of the state Bureau of Mines and Geology; John D. MacKenzie, manager of the East Helena plant of American Smelting & Refining; Russell B. Caples, general superintendent of the Great Falls reduction plant of Anaconda Copper Mining; Charles E. Pew, Helena attorney; C. M. Roos, head of the Vosburg and Fairview Syndicates; Harry C. Bacorn, vice-president of the association and president of Jardine Mining; Frederick C. Gilbert, Butte metallurgist and secretary of the association, and C. R. Brazier, of Helena. Resolutions were passed that dealt with state and national legislation.

Governor Frank H. Cooney of Montana has appointed the following on the Montana Copper Tariff Commission; W. B. Daly, of Butte, general manager of mines, Anaconda Copper Mining; Carl J. Trauerman, of Butte, president of the Montana Stock & Bond Company and president of the Mining Association of Montana; Samuel Barker, Jr., of Butte, past chairman of the Montana Section, A.I.M.E., and consulting engineer of Butte Copper & Zinc; Ed Donlan, mine operator of Missoula; Albert Wiggin, of Great Falls, Montana metallurgical manager of Anaconda Copper Mining, and Frederick Laist, of Anaconda, general metallurgical manager of Anaconda Copper Mining. These men were appointed at the request of Governor Moeur of Arizona to work with the southwest states group to promote a tariff on copper. Similar groups have been appointed in other copper-producing states.

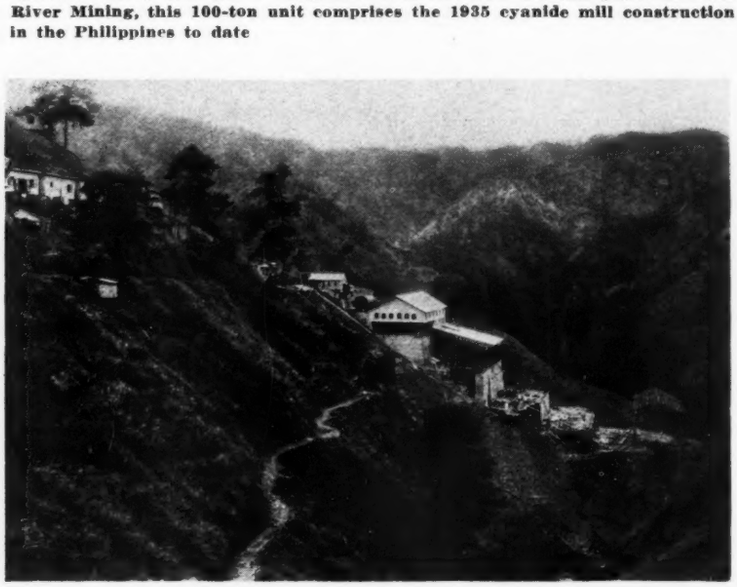
ARIZONA

• The Miami smelter of International Smelting, as stated in the foregoing, will resume operations this month, following a shutdown of three years' duration. The plant will operate on Miami Copper sulphide concentrate that has accumulated in the smelter bins during the last eight months. About 100 men will be employed under the direction of P. D. I. Honeyman, manager.

As already mentioned, announcement was made Feb. 13 of the acquisition by Phelps Dodge of a controlling stock interest in United Verde. This places Phelps Dodge ahead of Anaconda and second to Kennecott in productive capacity, as rated in the Copper Code. In 1934, the Copper Queen mine of Phelps Dodge, at Bisbee, led all other mines in Arizona in production of copper, gold, and silver. The New Cornelia branch, at Ajo, employing about 900 men, is shipping about 250 carloads of concentrate a month to the company's smelter at Douglas. United Verde resumed copper production in January after a shutdown of four years. Ore being smelted in the one furnace operated at the company's Clarkdale smelter is siliceous material from the lower levels of the United Verde mine, which ore contains considerable gold and silver. Construction of a 500-ton cyanide plant was announced two months ago. Robert E. Tally, formerly president of United Verde, has stated that the transfer of control will not affect these operations, which are giving employment to about 700 men.

(Continued on page 152)

• Mill of Demonstration Gold Mines nearing completion in the Baguio district, Philippine Islands. Dry weather in the district last October and November greatly expedited construction of the mill, which was placed in operation early this year. Together with the new 175-ton plant of Gold River Mining, this 100-ton unit comprises the 1935 cyanide mill construction in the Philippines to date



NEWS FROM WASHINGTON

By Special Correspondent

LAW MAKING continues as Washington's major industry, but the legislative gears have not meshed well lately, as there are many hot bearings in the machine, which shriek despite Presidential efforts at lubrication. Forecasting enactment of bills simply because they are "Administration measures" is no longer safe.

Despite the magnitude of the tasks ahead, Congress will carry through to enactment a majority of the measures which the Administration wants, but many of them in modified, if not mutilated, form. Already provision has been made for extension of RFC, with enlarged authority; for refinancing of the federal debt with a revolving bond pool of $25,000,000,000; for the issuance of baby bonds intended to stimulate popular interest in Government support; and a few other acts of more specialized non-mining significance.

Sure of enactment, and also sure of modification from Administration recommendation, are the work-relief bill, part of the old-age and unemployment security legislation (but by no means all of it), a vigorous public-utility holding company bill, and a *few* others of outstanding national importance, especially to business and agriculture. A national banking act, also sure, without substantial changes, should aid much in stimulating mine loans by banks.

Bigness Under Fire

"BIGNESS IS BADNESS" is the theme of Administration thinking today. Regulation of public-utility holding companies is but one symptom. Proceeding first to attack those agencies which are most in public disfavor, the Adminstration is likely to restrict other kinds of big business as well. This is not because the President or Congress have demagogic desires. Rather it is based upon sincere and deep-seated conviction that bigness in business is socially undesirable.

Congress will not this year go very far along this road, but some steps taken will have concern for every enterprise in which subsidiaries and parent companies are involved. Regulation will handcuff the parent companies to the Government policeman. And this officer will swing a big taxation club. This weapon will deliberately be used for extermination of certain types of holding companies, notably in the public-utility field. It is likely to bruise other heads also.

Monopoly regulation is again fashionable. Reestablishment of vigorous anti-trust measures can be expected. This movement has the definite support, almost the aggressive leadership, of the President. Clear evidence of this is found in his emphasis on curbing of monopoly trends, in the message asking for extension of NIRA for two years. Here again thorough conviction, as well as political expediency, inspires the effort.

Western Mineral Projects

BOULDER DAM power will be made widely available for mineral-resource development if recommendations to the Bureau of Reclamation and plans of that agency are furthered. This power, it is estimated, will cost at the generating station 1.93 mills per kilowatt-hour at 100 per cent capacity load factor, or 2.22 mills if used at 50 per cent load factor. It should be available in substantial quantities in the not distant future.

The fact that most of the power has been allotted to certain states or distributing agencies has led to the erroneous conclusion that marketing of the power is also provided for. Quite the contrary situation exists, and unless new industry is found there is no present prospect of consumption, even at a 50 per cent load factor. Costs of transmission from the dam, of course, greatly increase the production cost in the foregoing. This factor is the most serious encountered by those who are backing specific projects.

The RFC made a definite step in this matter when it granted a loan of $3,000,000 to Consolidated Coppermines, of Nevada, for further development of copper mining and milling facilities there. An additional request for a loan is pending before RFC by those who wish to build a power line from Boulder Dam into the territory about Ely and Pioche, Nev. Bureau of Reclamation officials are enthusiastic about this possibility, as it is the first definite move to secure commercial utilization of the anticipated large surpluses of power which will be generated by their Boulder Dam project.

Mining Securities

THE Securities and Exchange Commission is undertaking to set up more rigid restrictions on the offering to investors of securities by "private" sale. Officials of SEC state that evasion of the law is being attempted and that private offerings are being claimed when, in fact, the securities should first be registered with the Commission.

Attorneys of the Commission point out that the principal factor to be considered in determining whether an offering is private is primarily the relation of the offerees to each other and to the issuer of the securities. The mere number of persons making a purchase is not governing, especially when informal inquiries have first limited the "offering" to those believed ready to purchase in order to keep the number to 25 or fewer persons.

Officials of the SEC say that the procedure to secure registration and listing is now simplified to such a degree that no justification exists for past practices of this type. If difficulty is experienced in securing company cooperation, a more rigorous law will probably be sought later this session. This is of importance to mining companies, as they are most frequently cited as the ones seeking to evade registration of new stock issues.

Under the present restrictions applying to RFC loans, no possibility prevails of providing large sums for new tin developments such as have been proposed to Congress and erroneously reported in the press as under contemplation as a result of this act. Further legislation to facilitate tin development may be enacted, but it will be wholly independent of either RFC or SEC present plans.

Labor Laws

THE PRESIDENT asks, and will be granted, a two-year extension of NIRA to permit labor benefits and limited trade-practice regulation much like that of the past two years under Gold-fish-bowl Johnson. However, more stable and conservative methods will apply, although more drastic steps may be taken with respect to natural-resource supervision. Initially, coal, oil, and natural gas will be the mineral commodities to be supervised. But with any reasonable success in those fields, the Administration is sure to proceed in like manner to strengthen its regulatory effort on metals and non-metallic minerals.

Wages and hours will presumably be regulated mainly through NRA discipline, unless recent unfavorable court findings prevail. But Congress is rapidly coming to the conviction that it must enact a limited-hour week. A modified 30-hour week bill is freely prophesied by Administration leaders whose judgment is excellent. The President's opposition to this measure in the past will unquestionably be weakened if it proves a logical trading area within which to secure a realliance of labor and Government. For example, if the A. F. of L. will withdraw its demands for majority rule as a part of all NRA labor dealing, then the Administration may be disposed to grant a modified work-week bill.

At present the talk is for 40 hours

as the statutory limit on employment. But all recognize that some exemptions by industries, by geographic areas, or by types of service, are necessary. Almost certain of exemption are agricultural workers, domestic servants, and small-town intrastate business employees. The motive here is one of practicability quite as much as constitutionality.

The Wagner labor disputes legislation will also be pressed and some of it will be enacted. Part of the objectives sought may, however, be reached through amendments to NIRA or as riders on other legislation. This, of course, weakens the Senator's chance to put through his bill in all particulars requiring compulsory arbitration and a majority rule in labor settlements. Neither of these two objectives which he still tenaciously holds personally seem likely of adoption in full.

Potash Concentration

CONCENTRATION of potassium chloride from the New Mexican potash ores has been proved practical on a laboratory scale by a combination of differential wetting with tabling or jigging. Certain unusual, but not excessively expensive, organic chemicals wet the sylvite (KCl) and cause it to agglomerate but do not wet the halite (NaCl). Hence these two mineral constituents can be separated after reasonably fine crushing of the ore despite their closeness in specific gravty. Tabling, according to laboratory-scale tests of the Bureau of Mines, can produce a 95 per cent concentration of KCl with 96 per cent recovery. This means that commercially marketable potash-fertilizer salts can be prepared without the cost of recrystallization.

A substantial part of this work was done by the Bureau in cooperation with the Potash Company of America, which has its mine at Carlsbad, N. M. Expectations are that this company will soon develop larger-scale units for this process, to determine whether there can be realized in practice the anticipated large saving in cost for preparation of fertilizer material.

The Bureau of Mines is preparing plans for its new building in Tuscaloosa, Ala., for which PWA has provided $200,000. This building will be on the campus of the University of Alabama and will release to the University loaned space in the engineering building, which is severely overcrowded.

Mineral Treaties

PROMULGATION of the new trade agreement with Brazil providing for 50 per cent reduction in tariff on manganese ore imported into the United States clearly indicates certain trends of Administration thinking. Among the important conclusions to be reached are:

1. Minerals wanted by the United States are likely to receive tariff advantages, even when conspicuous domestic opposition is known to exist.

2. Adjustments in mineral tariffs will apply to all nations entitled to "most-favored-nation" treatment.

3. Countries like Russia with which diplomatic relations are not fully developed with respect to commercial matters will not necessarily get the benefit of these mineral tariff adjustments.

4. Cuba, formerly extra-favored in tariff matters, will not retain as much advantage as formerly when these adjustments on minerals seem necessary elsewhere.

5. Trade agreements, though moving slowly, are going to be arranged as rapidly as feasible, presumably a dozen or more being promulgated within the next year.

Cuban manganese, formerly imported without duty, is detrimentally affected by the Brazilian treaty decision, because it now has only half the differential formerly available. Some Washington specialists who estimate Cuban costs to be several dollars above costs elsewhere believe that the Brazilian treaty spells the doom of Cuban development, which has been going on aggressively in recent months, especially since the Cuban trade treaty was promulgated. These specialists forecast that United States supplies of manganese will now come almost exclusively from British India, Brazil, and West Africa, with only minor amounts from Cuba and the other small producers. Forecasting Russian supply is contingent altogether on questions of Administration policy, including legal questions of dumping, indentured labor, and our trade attitude toward the Soviet generally.

Following protests which came soon after the Brazilian treaty was announced, Secretary of State Hull took occasion to give sharp reprimand to those high-tariff groups which have been led by domestic manganese spokesmen. This attitude is regarded in Washington as a warning of importance. It is presumed, therefore, that domestic manganese producers are going to find increasing difficulty in making trades with others who may have like problems. Although not named explicitly, it was clearly at that group the Secretary directed his unusually caustic comment.

Tin Proceedings

NO RECOMMENDATIONS have as yet been made by the special committee on tin policy of the House of Representatives, which is continuing its studies through its mining specialist. Expectations are, however, that a preliminary report will be drafted for consideration of the committee in the near future. This report will undoubtedly consider the possibility of Government aid in research and resource surveys, as well as the necessary plans for domestic smelting and tin-ore import stimulation. Several important legislative features will be involved, and it remains doubtful whether full enactment of the policy in workable legal form can be accomplished at this session of Congress. Effort in that direction will be made, however.

• TAPPING END of lead blast furnace at the scrap plant of the United States Metals Refining Company, Carteret, N. J. The furnace treats principally slag, reverts, clean-ups, and various byproducts, and produces an antimonial lead for the softening furnace. Dust collection is a feature of the plant. At this furnace ducts are placed at the lead well, slag tap, settler matte tap, and settler lead tap. All individual ducts may be closed with butterfly dampers when no fume is generated

Committee Increases Appropriations For Bureau of Mines and the Survey

Recommends $202,385 More for Bureau and $794,060 More for the Geological Survey—Director of Bureau Announces Personnel of New Advisory Board—Reconstruction Finance Corporation Liberalizes Loan Provisions

RECOMMENDATION of an increase of $202,385 in the appropriations for the Bureau of Mines has been made by the Appropriations Committee of the House of Representatives. This would make $1,417,311 available for the work of the Bureau during the next fiscal year. For mineral mining investigations the committee recommended $128,860, which is $42,886 more than the 1935 appropriation and is an increase of $30,000 above the recommendation of the Bureau of the Budget. The committee increased the item so as to allow an expansion of the work in connection with geophysical methods of prospecting. So as to provide for additional work on the beneficiation of ores and coal in the Pacific Northwest and Alaska, the committee added $5,000 to the appropriation for the mining experiment station, bringing the total for that purpose to $140,450.

A total of $2,107,560 was recommended for the Geological Survey. This is an increase of $794,060 over the appropriation for the current fiscal year. This practically brings the appropriation back to the pre-depression level. The committee added $10,000 to the budget estimate for geological surveys, making $335,000 available for that purpose.

Dr. John Wellington Finch, Director of the Bureau of Mines, states that he is particularly proud to announce the personnel of a new Bureau of Mines Advisory Board which he just has set up. Twenty years ago, he points out, it would have been impossible to induce representatives of industry and labor to sit down around the same table to discuss such problems as come before the Bureau. The personnel of the Board and the groups represented are as follows:

BUREAU OF MINES ADVISORY BOARD

Eastern Bituminous Coal Producers

JAMES P. WILLIAMS, JR., president, National Coal Association, Southern Building, Washington, D. C.; vice-president, Koppers Coal Company; address: 1050 Koppers Building, Pittsburgh, Pa.

Alternate—LEWIS E. YOUNG, vice-president, Pittsburgh Coal Company, Pittsburgh, Pa.

Eastern Anthracite Producers

LOUIS C. MADEIRA III, executive director, Anthracite Institute, 19 Rector Street, New York, N. Y.

Alternate—CADWALLADER EVANS, JR., general manager, Hudson Coal Company, Scranton, Pa.

Western Coal Producers

EUGENE McAULIFFE, president, Union Pacific Coal Company, 1416 Dodge Street, Omaha, Neb.

Alternate—D. S. HANLEY, vice-president, Pacific Coast Coal Company; secretary-treasurer, Coal Producers Association of Washington; Secretary, District VII Code Authority of Division V; address: Pacific Coast Coal Company, Seattle, Washington.

Mining Employees

JOHN L. LEWIS, president, United Mine Workers of America, 712 Tower Building, Washington, D. C.

Alternate—A. D. LEWIS, United Mine Workers of America, 712 Tower Building, Washington, D. C.

Mining Employees

WILLIAM GREEN, president, American Federation of Labor, A. F. of L. Building, Washington, D. C.

Alternate—THOMAS H. BROWN, president, International Union of Mine, Mill and Smelter Workers, 910 Waukeska Street, Butte, Mont.

Oil and Gas Field Workers

H. C. FREMMING, president, International Association of Oil Field, Gas Well and Refinery Workers of America, 1130 Barr Building, Washington, D. C.

Alternate—JOHN L. COULTER, secretary-treasurer, International Association of Oil Field, Gas Well and Refinery Workers of America, 1130 Barr Building, Washington, D. C.

Copper Industry

CLEVELAND E. DODGE, vice-president, Phelps Dodge Corporation, 40 Wall Street, New York, N. Y.

Alternate—

Silver, Lead and Zinc Industries

H. A. GUESS, vice-president in charge of mining, American Smelting & Refining Company, 120 Broadway, New York, N. Y.

Alternate—FRANK M. SMITH, smelter director, Bunker Hill Smelter, Kellogg, Idaho.

Non-metal Mineral Industries

OTHO M. GRAVES, president, General Crushed Stone Company; ex-president, National Crushed Stone Association; chairman, Code Authority, Crushed Stone, Sand and Gravel, and Slag Industries; address: Drake Building, Easton, Pa.

Alternate—

Mineral Policy and Government Committee

C. K. LEITH, member, Science Advisory Board, Planning Committee for Mineral Policy, Business Advisory and Planning Council for Department of Commerce; chairman, Department of Geology, University of Wisconsin, Madison, Wis., or Room 5241 Interior Building, Washington, D. C.

Alternate—

Mining and Metallurgical Engineering

HOWARD N. EAVENSON, ex-president, A. I. M. & M. E.; address: Eavenson, Alford & Hicks, 2050 Koppers Building, Pittsburgh, Pa.

Alternate—

Liaison Representative for Mining Industry in General

HOWARD I. YOUNG, president, American Mining Congress; president, American Zinc, Lead & Smelting Company, St. Louis, Missouri.

Alternate—JULIAN D. CONOVER, secretary, American Mining Congress, Munsey Building, Washington, D. C.

Iron and Steel Industries

THOMAS M. GIRDLER, vice-president, American Iron and Steel Institute; chairman of the board and president, Republic Steel Corporation, Union Trust Building, Cleveland, Ohio.

Alternate—

Petroleum Industry

AMOS L. BEATY, director and member, executive committee, Phillips Petroleum Company; director, American Petroleum Institute; address. 80 Broadway, New York, N. Y.

AXTELL J. BYLES, president, American Petroleum Institute, 50 West 50th Street, New York, N. Y.

Alternate—W. R. BOYD, JR., executive vice-president, American Petroleum Institute, 50 West 50th Street, New York, N. Y.

Gas Industry

FRANK L. CHASE, ex-president, Natural Gas Association of America; second vice-president and operating manager, Lone Star Gas Company, 1915 Wood Street, Dallas, Tex.

Alternate—J. D. CREVELING, Advisory Council American Gas Association; address: Henry L. Doherty & Company, 60 Wall Street, New York, N. Y.

Explosives and Research

J. THOMPSON BROWN, vice-president, E. I. duPont de Nemours & Company, Wilmington, Del.

Alternate—

Health and Safety Appliances

JOHN T. RYAN, vice-president and general sales manager, Mine Safety Appliances Company, Braddock, Thomas and Meade Streets, Pittsburgh, Pa.

Alternate—E. W. Bullard, president, E. D. Bullard Company, 275 Eighth Street, San Francisco, California.

WITH the liberalization of the mining loan provision of the Reconstruction Finance Corporation Act a flood of letters of inquiry are reaching the Corporation asking for information concerning those loans. Under the revised statute the RFC is authorized to make loans upon "sufficient" security rather than "adequate" security to individuals and corporations engaged in the mining, milling or smelting of ores. Loans may be made for the development of veins or for orebodies or placer deposits containing gold, silver, or tin, when in the opinion of the RFC "there is sufficient reason to believe that through the use of such loan there will be developed a sufficient quantity of ore or placer deposits of sufficient value to pay a profit upon mining operations." Loans are not to exceed $20,000 for this latter purpose and the total of such loans may not exceed $10,000,000. The Corporation has revised its Circular 14, which contains the conditions under which applications will be considered and loans made.

Criticism to the effect that the recent RFC loan of $3,000,000 to Consolidated Coppermines is adding unfairly to the overproduction of copper is met at the Washington, D. C., headquarters of the RFC with the statement that the Copper Code, signed April 24, 1934, provides an allotment of 13,608,000 lb. of copper for this producer. More than that, the RFC points out, the ore from these properties runs relatively high in gold and silver. The original application of the company was for $7,000,000, so as to make possible the construction of a smelter. The RFC was unwilling to add to the country's smelting capacity, so a smaller loan was granted in the belief that a mill could be erected and the smelting done at existing establishments. In addition, the full loan was said to be amply secured by the ore already blocked out in the mine.

Canadians Assemble at Winnipeg To Discuss Achievements

Annual Meeting of Institute of Mining and Metallurgy Convenes March 12, With Discussions Centering Around Mineral Development of Manitoba and Rapid Growth of Mining Industry in That Province

WINNIPEG has now joined definitely the mining centers of this continent. Six years ago it entertained, for the first time, the Canadian Institute of Mining and Metallurgy at its annual meeting. On March 12-14 the annual meeting will be held again in Winnipeg, to be followed on March 15-17 by an excursion to Flin Flon.

Manitoba has well established base metal and gold industries, besides important non-metallic mineral industries, and these will be represented prominently on the Institute's program. A series of ten papers on Flin Flon is the principal feature. Establishment of the 3,000-ton mine, concentrator, and smelter, with zinc refinery and 39,000-hp. power plant by R. E. Phelan and his staff in record time in this remote part of the province, is a feat that will be long remembered in the annals of Canadian mining.

San Antonio, a youthful mine with high-grade ore in substantial quantities, is to be described by D. J. Kennedy and his staff. Gods Lake mine, which will commence to produce bullion from its 150-ton mill next fall, will also be the subject of a paper. The Rice Lake field, comparatively near to the railway northeast of Winnipeg, has as yet only the two mines San Antonio and Central Manitoba; but it seems likely that Forty Four and possibly also Gabrielle, adjoining San Antonio, will develop into profitable operations. Gunnar Gold, in the same field, also has a substantial block of ore in sight above the 500-ft. level and will probably be equipped with a mill during the coming summer.

Development in the far north of the province has reached an interesting phase. Discoveries are all on the shores or islands of a series of large lakes, where they were discovered readily by canoe after the prospectors had been brought in by airplane. The original development, at Island Lake, 150 miles from the railway, remains disappointing, the extensive and rich surface showings being cut off close beneath the surface by a fault whose secret has not yet been revealed. Gods Lake mine, to the north and nearer the railway, has shown substantial amounts of ore mining from ½ to 1 oz. gold down to the 200-ft. level, with good indications by diamond drilling below this and for a length of almost two miles. About 6,000 tons of equipment for a 1,900-hp. power plant and 150-ton mill are being hauled in by tractor train over the winter road, 130 miles long. At Knee Lake, crossed by this road, Cyril Knight Prospecting is developing a showing found last summer that consists of a similar volume of ore of even higher grade, as indicated by recent diamond drilling. At the adjoining property of Knee Lake Gold Mines, under option to Bobjo Mines, a shaft is being sunk, following favorable drilling results. The grade needs to be comparatively high, of course, in this remote region for property to pay. But from present indications costs will be by no means excessive. These are only the first discoveries in what promises to be a broad and productive gold field in northern Manitoba.

BRITISH COLUMBIA

• Severe winter weather in British Columbia, with heavy falls of snow in the interior, has interfered only slightly with mining activity. Delays in transportation occurred both on railways and roads, but sufficient supplies were on hand in most camps to prevent shutdowns.

The Nelson district continues to be the most active area in the number of gold mines being brought to the productive stage. The new 100-ton mill at the Yankee Girl mine is working satisfactorily and treating 90 tons or more per day. Financing arrangements completed by Gold Belt Mines will net the treasury $52,000, which will be used to build a tramway and a 50-ton mill.

The old Queen mine, controlled by Sheep Creek Gold Mines, is responding well to development. After picking up the vein west of a big fault on the seventh level, drifting has shown a vein width up to 16 ft. of milling ore. Work has been temporarily suspended on this drift and a crosscut started on the third level to prospect for the upward continuation of this 16-ft. vein. The new working shaft to the seventh level has been completed by raising, and sinking to the eighth level has been started. Production from the Reno mine in January was valued at about $71,000, the highest monthly report to date. Developments on the seventh and eighth levels are reported as being satisfactory.

Ore of good milling grade is reported on the eleventh level of the Bralorne mine. When first opened up, ore on this level was very low-grade, which gave rise to unfounded rumors that values had petered out at depth. The C vein on the eleventh level is also reported to be showing good ore. Mill operations are practically up to the daily capacity of 450 tons.

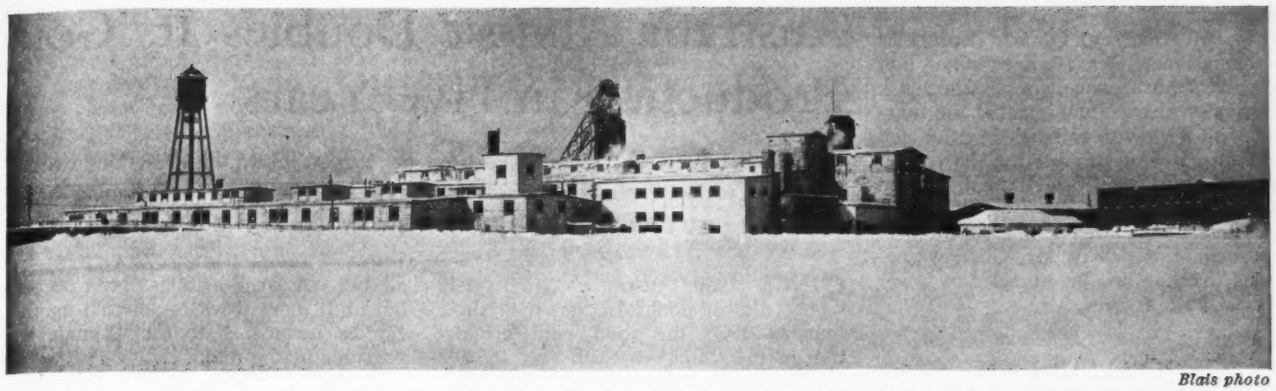
Steady production at the Minto mine at the rate of 50 tons per day is being maintained, and, with the addition of four new flotation cells, the plant is expected to treat 75 tons per day. The company reports 100,000 tons of proven ore and no difficulties in mill treatment on account of complexity of the ore.

The deep development program at the Pioneer mine is proceeding steadily. The present bottom level is the fourteenth, and twelve new levels, 125 ft. apart, are to be opened below this. The shaft is down about to the 21st level. Stations are cut at each level, but no crosscutting will be done until shaft sinking is completed to the 26th level, or 3,200 ft. below the surface. Ore reserves last May were given as 432,000 tons, and the understanding is that they are larger now. Rich ore has been opened up on the fourteenth level on the main vein. The footwall vein on this level, on which 1,000 ft. of drifting has been done, is showing workable widths and values.

Substantial progress in developing new ore is being made at the Dentonia mine, at Greenwood. High-grade ore was encountered in the raise from the 500-ft. level, which is the main haulage adit for the mine. This was struck about 135 ft. below the 200-ft. level, where a large oreshoot was mined out last year. The raise is being carried up as a stope, and mill feed of 80 to 90 tons a day is being drawn from it. The vein is several feet wide. Value of the production for February is estimated by the management at about $40,000. The main development for 1934 was the long crosscut on the 500-ft. level, but drifting and raising on the vein should shortly encounter oreshoots.

An event of considerable importance to the Cariboo district was the issuance of a detail report on the Consolidated Gold Alluvials by D. Campbell Mackenzie, manager. This property, at Wingdam, Lightning Creek, was controlled by C. H. Unverzagt for 30 years, and, although a million dollars or more was spent on it, no success was attained in mining the deep bedrock gold. Two years ago the control was acquired by English capital and last July Campbell Mackenzie was brought from Australia to take complete charge of the property. His report, a most enthusiastic one, is based on six months' study, including much Keystone drilling. An operating profit of $1,125,000 a year is estimated by him, once the property is properly opened. So far the English interests have spent about $500,000, have brought in an excellent power plant, and work is proceeding energetically with more than 100 men employed.

According to reports, Cariboo Hydro-Electric Power, controlled by English capital, will proceed with the harnessing of Swamp Falls to supply electricity



Blais photo

• Winter in the Kirkland Lake gold belt of northern Ontario, Canada. Above—Lake Shore Mines. Below—Wright-Hargreaves Mines. In 1934 these two properties produced the major part of the gold mined in the Kirkland Lake district, Canada's leading gold district

in the Barkerville district. This power would be supplied to Cariboo Gold Quartz and Island Mountain as well as to the towns of Barkerville and Wells. An initial market of 1,500 hp. is indicated, and other mining operations may in the future add to this.

Output of Island Mountain's 50-ton mill for November and December was valued at about $55,000. The replacement orebody is said to be responding well to development. This is a heavy pyritic replacement in limestone, occurring in vein-like form. Average width is about 4 ft.

In the Fairview camp, Morning Star reports cutting good grade ore 3 ft. wide in a crosscut 40 ft. below the No. 1 level, at the south end. This is an extension downwards of the No. 1 orebody, a small oreshoot from which shipping ore has been taken. Other development consists of raising from the No. 1 level at the north end and sinking of a winze in the same area.

A new low tunnel has been started on the Monashee mine, which is under option to Vidette Gold Mines. This is 150 ft. below the 3,900 tunnel, and is expected to intersect the vein at a distance of 220 ft. The diamond-drilling campaign at the Windpass mine has been successful in finding the orebody below No. 5 level. Several holes have cut good widths and values over a length of 180 ft. Steady production is being maintained with the mill handling 50 tons a day.

The main vein in the Home Gold property is said to have been cut at the 500-ft. level, showing a width of 15 ft. The present 25-ton mill on the property is being used as a pilot mill.

Vancouver Island Gold Mines is exploring underground two of the ten known veins on its property. Smelter returns on the first 40 tons shipped gave 2.86 oz. gold per ton. High-grade ore is being stored pending development results, to see if erection of a small mill is warranted.

ONTARIO

• International Nickel's announcement of progress in its present campaign of expansion illustrates clearly the amazing rapidity of nickel's advance in industry. Although the uses of war are still served to some extent by the metal, as by every other metal, the arts of peace now consume by far the larger part of the output. Four new converters are completed, and two spare reverberatories have been put in operation at Copper Cliff. To meet this increased capacity, 30,000 tons of ore per month additional is being drawn from the Frood mine. The new hoist at Frood is in operation, and the capacity of the mine is still well ahead of smelter requirements. As the Frood ore produces about 2 lb. copper for each pound of nickel, the Port Colborne nickel refinery still has spare capacity, and an additional electrolytic unit with 800,000 lb. monthly output has been put in operation. To meet the expanding market for Monel metal, the Creighton mine, used exclusively to feed the smelter at Coniston, is to be equipped with a new 6-compartment shaft to serve the lower levels, which will double the mine's hoisting capacity.

Equipment for the 125-ton mill of Pickle-Crow and for the hydro-electric power plant to serve it and Central Patricia is on the ground, and the mill is expected to be in operation, using electrical power at $65 per hp., in April. Development to a depth of 375 ft. continues to show ore of good grade over widths of about 3 ft.

The substantial nature of present operations at Matachewan is shown by the official bullion record for January, which is 2,788 oz. worth $97,016. In order of their output, the three producers are Young-Davidson (subsidiary of Hollinger), Ashley (subsidiary of Mining Corporation) and Matachewan Consolidated (controlled by Ventures). An interesting fact is that the first and third of these, at one time the basis of rather doubtful promotions, have finally been brought into operation by established mining companies.

Bobjo Mines has stopped operations at its Manitoba & Eastern property in Timagami, the lenses of ore having been shown to be too small for profitable operation, though of good grade.

Responsibility for the market crash in Gunman Gold shares last October has

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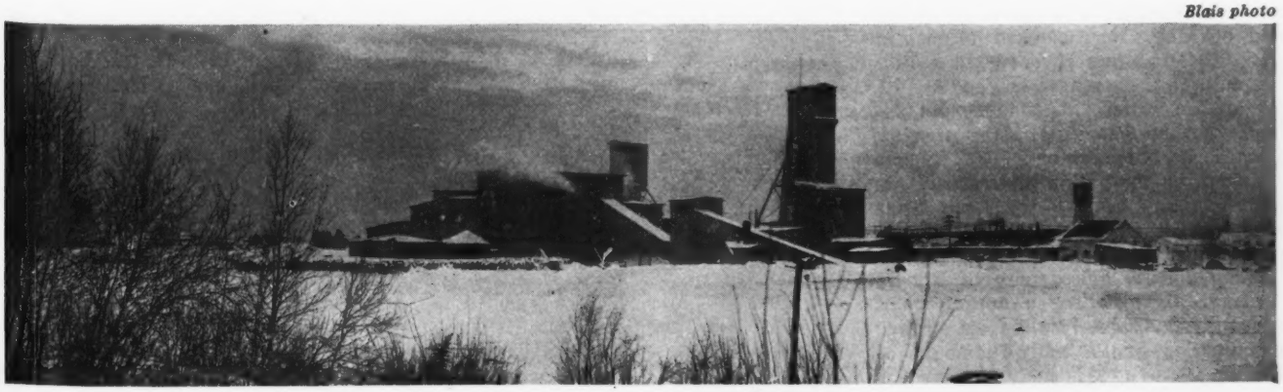


been laid publicly on J. H. Hirshhorn by J. M. Godfrey, Ontario Securities Commissioner. Mr. Godfrey states that Mr. Hirshhorn, who held a large block of vendor shares, manipulated the market with a view to raising the price and sold at prices up to $2.48 the shares that had cost him about 8c. As manipulation of this kind by one person is not legally a crime, in distinction to conspiracy to manipulate, which is, Mr. Godfrey suggests that the law be amended to cover such a case as this.

QUEBEC

• Discovery of gold at Rose Lake, midway from the Canadian National Railway at Senneterre to the Chibougamau field, but 40 miles north of the water route, enhances the prospect for adequate transportation facilities through this part of the province. Twenty-five years ago when the Chibougamau district was first examined by a commission appointed by the Quebec Government, the projected route was northward from Lake St. John, and no mineral areas had been delineated along this 200-mile route. Today the prospect is much better for a northeast-northwest railway line from Senneterre or thereabouts to serve the Chibougamau area and the intermediate mineral-bearing areas. At Opemiska, 40 miles west of Chibougamau, substantial deposits of copper-gold ore exist, whose volume has been increased by prospecting during the past summer. At Rose Lake the discoverers, Prospectors Airways, have arranged to drive a 700-ft. tunnel to intersect the various gold-bearing veins at a depth of 150 ft. Preliminary surface examination has indicated shoots of ore in several veins running from ½ to 1¼ oz. across a width of 2 ft. In the Chibougamau area itself development is at a more advanced stage. Consolidated Mining & Smelting is sinking to a depth of 250 ft. to open its gold-copper deposits at Cedar Bay, which gave good results from diamond-drilling. Noranda has an interesting gold prospect at Lake Bourbeau, 8 miles to the north, where drilling has indicated a minable deposit, provided transportation facilities are improved.

The 150-ton mill of Canadian Malartic is expected to be in operation by the end of May. Perron Gold Mines, in Pascalis Township, has ordered a 100-ton mill, on the strength of good results to the 325-ft. level. At Tiblemont Island, the shaft is progressing steadily towards its objective of 500 ft. Vicour is preparing to develop underground its extensive gold-bearing zone, somewhat similar to that of Bussières and Lamaque. At Mud Lake, east of Lake Timiskaming and 40 miles south of Rouyn, McIntyre is installing a mining plant following favorable results from surface examination and a limited amount of drilling.

Australia Almost Doubles Its Gold Production in Five Years

Interest in Western Australia Focused on a New Gold Field at Yellowdine, Reported to Be Probably the Most Important Discovery in Recent Years—Bulolo to Increase Digging Depth of Dredges From 25 to 125 Feet

SINCE 1930 Australia's gold yield has almost doubled. Statistics show that in 1930 the total gold production of the Commonwealth was 466,593 oz.; in 1931, 595,123 oz.; in 1932, 713,882 oz.; in 1933, 830,332 oz.; and the 1934 output is estimated at 877,398 oz. Marked increases in production are shown in all the states with the exception of Tasmania, where the gold is obtained as a byproduct by the Mount Lyell company.

At Broken Hill, N.S.W., 1,253,204 tons of crude ore was treated in 1934, for a recovery of 236,082 tons of lead concentrate and 237,084 tons of zinc concentrate. The lead concentrate assayed between 75.5 and 76.5 per cent lead, depending on the mine of origin, and the zinc concentrate assayed from 52.5 to 53.5 per cent zinc. Costs during the year averaged 24s. per ton, including 2s. per ton for development.

Bulolo Gold Dredging now has four dredges in operation at its New Guinea property. During 1934 the company handled 8,471,200 cu.yd. of gravel, recovering 108,278 fine ounces of gold. The average yield was 6.15 grains of fine gold; the working cost 7.3d. (Australian) per cubic yard; and the working profit, £659,000.

WESTERN AUSTRALIA

• Great interest is being taken in the new gold field at Yellowdine, 37 miles east along the east-west railway line from Southern Cross. The find is probably the most important new gold field since the beginning of this century. Only a small amount of work has been done to date, but shallow shafts and crosscuts are said to have proved 30,000 tons of ore assaying 2 oz. At 50 ft. a crosscut from one shaft is reported to have shown a width of 57 ft. assaying 52 dwt. A large area has been pegged, but until more work is done no opinion can be formed as to the ultimate importance of the find.

Triton Gold Mines, which have been developing the Reedy's mine, at Cue, has decided to install a plant to treat 60,000 tons annually. The main ore-shoot has been proved to be 800 ft. long and 8 ft. wide. The mill will be in operation by July of this year.

QUEENSLAND

• Mount Morgan is reported to be treating 15,000 tons of ore monthly that assays 5.5 dwt. gold and 0.7 per cent copper and producing therefrom concentrate assaying more than 5 oz. gold per ton. Through improved treatment methods, more than 2,000,000 tons has been added to the company's ore reserves. These methods have increased recovery by 0.35 dwt., increased the ratio of concentration from 22 to 1 to 30 to 1, and, allowing for extra cost of reagents including cyanide and charcoal, a net saving in costs of 3.2s. per ton has been effected. The dump of 1,000,000 tons assays 2.3 dwt. per ton, and initial experimental work shows that the material can be treated profitably. The company plans to spend over £110,000 on new plant and equipment during the next nine months. The company has also formed Mount Morgan Developments, Ltd., to engage in the search for gold properties. The capital of the new company is £110,000. An option has been acquired over 156 acres at Swan Bitter in Western Australia, and other properties are under investigation.

NEW SOUTH WALES

• Mount Isa Mines has almost completed the mining of its oxidized ore. This month the plant will treat only sulphide ore and will recover both lead concentrate and zinc concentrate, the latter for dispatch overseas. The feed will come principally from the Black Star lode and will contain about 5.3 oz. silver, 8.1 per cent lead, and 9.1 per cent zinc. Although the company sustained a loss of £166,315 for the year ended June 30, 1934, the position at Mount Isa is said to be by no means hopeless, and any slight improvement in metal prices will enable the company to operate at a profit after meeting interest and depreciation. The mine

A.I.M.E. Elects New Officers At Annual Meeting

At the annual meeting of the American Institute of Mining and Metallurgical Engineers, held in New York on Feb. 18-21, the following officers and directors were elected: Henry A. Buehler, president; John M. Lovejoy and Paul D. Merica, vice-presidents; Dr. Charles K. Leith, Edwin E. Ellis, Wilber Judson, Wilfred Sykes, and Ralph M. Roosevelt, directors.

product for the last financial year was valued at £789,505 and the mine expenditure was £741,374. Working costs have been reduced from 31s. 11d. per ton of ore milled in 1931-32 to 22s. 10d. in 1933-34; mill recoveries and smelting operations have been improved greatly.

Ore reserves at the Occidental mine, at Cobar, have recently been estimated at 316,000 tons assaying 8½ dwt. A large additional tonnage exists in the upper levels, assaying 5 dwt., which will probably be treated at a profit. A plant to treat 9,000 tons monthly is being erected and will be in commission this month. The main shaft is to be sunk from its present depth of 840 ft. to 940 ft. and then to 1,040 ft.; levels opened at both points. Each level will add 110,000 tons to ore reserves, according to reports.

NEW GUINEA

• Bululo Gold Dredging, whose successful equipment of its dredging leases has been one of the outstanding events of recent years, intends to install additional dredges with a digging depth of 125 ft. The present dredges dig only to 25 ft. Boring is said to have definitely proved that the present bottom is false and that 100,000,000 cu.yd. of gravel carrying gold valued at 25 to 40c. per cubic yard (gold at $35 per fine oz.) exists from depths of 60 to 180 ft.

New Guinea Goldfields is erecting a twenty-head battery and cyanide plant on its upper leases. The capacity is to be 100 tons daily. The ore reserves of this section are said to total 118,000 tons assaying 11.4 dwt. Three orebodies are being developed. On the lower or Golden Ridges area, where the soft manganiferous lode is mined in open cuts, the treatment plant has been extended to handle 3,200 tons monthly.

Value of Rand January Gold Output Establishes a New Record

Correspondence from London

THE RAND gold output in January was 890,875 oz., compared with 866,037 oz. in December, and 907,641 oz. in January last year. In total value the January output is said to have established a new high record of £6,280,670 owing to the inflated price of gold. The previous high record was £6,199,390.

Hopes of tax relief in the forthcoming Union of South Africa budget are being abandoned. The government has a large expenditure plan in view. Suggestions have been made that the government may agree to a division of the premium above the normal gold price on a fifty-fifty basis in lieu of the usual taxation, but this seems to be nothing more than a suggestion.

A Johannesburg dispatch dated Feb. 5 stated that earth tremors had occurred in the Germiston area of the Rand, causing falls of rock which killed four natives in the Witwatersrand Deep mine, and killed one and injured eight in the Geldenhuis Deep. In the Simmer and Jack mine about 30 stopes were abandoned temporarily on account of the dangerous movement of rock. Whether the tremors were the result of a slight earthquake shock, or of caving ground in abandoned workings, has not been stated. No recurrence has been reported.

Exploration of the Yellowdine gold discovery in Western Australia by Commonwealth Mining & Finance has produced a sensation in London. The first two diamond drills which were expected to prove the depth of the deposit to 200 ft. or more both failed to find either the reef or any commercial ore. However, this has not convinced the engineers that the great deposit, having a width of 5 ft. to 57 ft. over a length of 1,100 or 1,200 ft. on the surface, and said to carry more than 2 oz. of gold per ton to a depth of about 50 ft., has completely vanished within a further depth of about 150 ft. The options for the purchase of the property have been exercised. John A. Agnew, chairman of Gold Fields Australian Development, which has a 20 per cent interest in the Yellowdine property, arranged for three engineers to examine the ground. From these examinations the opinion has emerged that the ore occurs in a synclinal trough, and that both drills may have passed underneath the reef. A third hole was started, presumably on this theory, and was lost at a depth of 133 ft. Another is now being drilled.

The foregoing theory of engineers concerning the Yellowdine property seems to have been confirmed—namely, that the two boreholes which failed to find values had gone under the ore. "No. 4 borehole completed at 183 ft.," says a cable received later by Commonwealth Mining & Finance. "Between 40 ft. and 88 ft., preliminary assays show values from 23 dwt. to 7 oz. Former assays taken from 88 ft. horizon. From 88 ft. to 107 ft. solid quartz not yet assayed."

A borehole has proved the theory that the gold measures of the Rand do persist in the so-called "Far West Rand" area. Borehole No. 13 drilled on Farm Libanon by West Witwatersrand Areas found the reef at approximately the depth calculated, namely, 3,571 ft. The values revealed have been calculated as 7.9 dwt. over a true width of 54 in., but the reef channel is said to average 5.1 dwt. over a width of 8 ft. Final correlation cannot be made till the Jeppestown shales are intersected; drilling is continuing.

One prominent independent engineer is quoted as declaring of the Borehole No. 13 in West Witwatersrand Areas intersecting the reef at a depth of 3,571 ft.: "It is the most noteworthy mining discovery of the present generation, as definitely proving the existence of the far western extension of the Main Reef."

An announcement has been made that Soviet Russia's gold production last year amounted to 4,681,600 oz.

• Miami, Ariz., smelter of the International Smelting Company, which will resume operations this month following a shutdown of three years' duration. About 100 men will be given employment. The plant will operate on concentrate from Miami Copper that has accumulated in the smelter bins during the last eight months

(Continued from page 144)

The Swastika property, at Cleator, has been acquired by a group of Iowa men organized as Swastika Mines. Production and development are under the direction of O. I. Tawney, mine superintendent.

Molybdenum, Inc., at Tucson, is mining and milling 25 tons of ore daily from the Helvetia Copper property. The mine has been developed by tunnel and shaft to a depth of 500 ft. Flotation is used to recover the molybdenum.

A three-compartment shaft has been sunk from the 140 to the 400-ft. level by Comstock-Dexter, at Hillside. Stations have been cut at the 260 and 360-ft. levels, preparatory to crosscutting to the vein.

Exploration work has been started on the Sayer-Lola claims, 70 miles south of Kingman, in Mohave County. A development shaft to the 200 level, on a 45-deg. incline, is planned to supplement present trenching and tunneling. The gold ore carries as much as 2 per cent copper. In the same Owens district, Hurley-McCracken is erecting a 25-ton mill to treat a lead-silver ore. Ore is being hauled to the stamp mill operated by G. R. Dean from numerous small development operations in the district.

Bagdad Copper plans activity at Hillside. E. B. Bronson, president, has outlined development of molybdenum and lead-silver deposits, as well as mining of zones of high-grade copper, but no attempt is to be made to mine the large low-grade copper orebody for which the 10,000-ton plant was built.

Crown King Consolidated is shipping ore from a winze on the old adit level. Drifts are being run from the new shaft.

A contract has been let for extending the tunnel of the Oro mine, at Ruby, to connect with the 150-ft. level of the Julia shaft, for the purpose of unwatering the upper workings.

The Mellgren mine, at Tombstone, is planning to sink a 600-ft. shaft and to drive drifts at depths of 300 ft. and 600 ft. Fissure veins have been explored to a depth of 200 ft., producing some ore of shipping grade.

Hillside Mines plans to sink from the 500 to the 700 level. A 450-hp. Fairbanks-Morse generator has permitted the flotation mill capacity to be increased to 200 tons a day. About 90 men are employed. H. L. Williams is president and manager. Nearly 25 tons of concentrate is shipped daily to the Magma smelter at Superior.

Tailing of Harqua Hala Bonanza, at Salome, is being treated in a 100-ton cyanide mill. Three clean-ups in December were reported by M. M. Carpenter, manager.

Arizona Magma, at Chloride, plans further development of the property, which is operated through a 500-ft. shaft. A 50-ton mill will be erected following blocking out of ore.

A high-grade oreshoot has been encountered in drifting from the bottom of the 120-ft. shaft of the Maricopa Chief property, which is across the line from the old North Star mine, in Yuma County. At the Kullman-McCool property, near Hayden, arrangements are being made for the immediate installation of a 25-ton milling plant.

MINNESOTA

• One of the principal indoor sports at this time of year, especially among Minnesota mining men, is watching the rate of steel production in the United States, month by month. This information gives the best basis for estimating iron-ore production for the next season. Up to the present steel production shows that at least 30 million tons of iron ore will be required. If this production increases, the iron ore region many have a 40-million-ton season.

With the State Legislature in session, the politicians of the range are busy at St. Paul, endeavoring to draw up a bill allowing the mining companies to purchase North Hibbing. Some progress has been made, but to frame a bill satisfactory to all parties is almost impossible.

Mexican Mining Activity Increases As Labor Disputes Are Settled

SETTLEMENT of labor conflicts and expansion of operations in several regions featured Mexican mining activities last month. New labor contracts, for instance, ended disputes between workers and the Campañia Minera de Chururribari, operating in the Nacozari district, Sonora. Establishment of a minimum daily wage of 2.50 pesos (about 70c. U. S.) settled a strike that involved 200 employees of the Chihuahua unit of Naica Mines of Mexico. Mine employees of the Cia. Min. Real del Monte y Pachuca, operating at Pachuca, Hidalgo, have withdrawn a strike threat following the signing of new collective labor contracts.

Neg. Min. Guadalupe de los Reyes, is obtaining ore that contains considerable gold and silver from its Zapote mine, Cosala municipality, Sinaloa, and is working mineral tracts in the San Miguel zone of that municipality with good results. The Buenavista and La Paloma mines, Cosala municipality, are being worked on a favorable basis. Large numbers of prospectors are working the Grano de Oro lot in the Placer de Guadalupe, Aldama municipality, Chihuahua, owned by Pascual Garcia.

A vein, about 8½ meters wide, producing ore that assays from 4 to 5 kg. per metric ton, is reported to have been discovered in the Dolores mine of American Smelting & Refining at Angangueo, Michoacan. Extensive operations in the Angangueo sector are said to be planned by the company.

A Mexico City district court judge rejected suits to restrain the San Luis Potosi government from putting into effect a recently enacted state law calling for expropriation as a public utility of the residues of their worked out mines brought by the Asarco, Metallurgica Mexicana, and Minera Nacional mining companies. Plaintiffs asserted they are entitled to these residues as they are on their properties and these lands are under federal but not state jurisdiction. The judge held that expropriation is constitutional and that San Luis Potosi was within its rights in decreeing such action, which was for social benefit. Mexican presidents are authorized to legislate in matters concerning mining throughout Mexico, under a bill congress has passed.

Cia. Min. Santa Maria del Oro and the Durango government are developing plans for the building of a road 8 km. long, extending from Magistral, where the company has its mines, to El Oro. Guanajuato Reduction and Mines has asked the federal authorities for sanction to lay off a considerable number of employees at its La Valenciana mine near Guanajuato City, contending that new explorations of the property have not been satisfactory. Cia. Min. La Piedra Bola has requested authority to suspend work at its Piedra Bola mines, Jalisco, asserting that operations are unprofitable because of the exhaustion of several workings.

Preparations for working tracts it controls near Huahutla, Morelos, are being made by Cia. Explotadora de Minas. Plants for treating low-grade ore obtained by cooperative societies of mining company employees who were dismissed when the enterprises slashed personnel, are to be established at Zacatecas City, Concepcion del Oro and Pilos, Zacatecas, by the state, federal, and municipal governments, as these societies find that to send their ore to smelters at San Luis Potosi or Monterey is too expensive.

PERSONAL ITEMS

J. P. Norrie, manager of the Perron gold mine, in Quebec, is installing a 100-ton cyanide mill.

Roy Brehaut has joined the staff of the Gods Lake gold mine, in northern Manitoba.

A. A. McMartin has purchased the Dik Dik gold property, east of Lake Nipigon, Ontario, and is equipping it with a 25-ton mill.

C. H. Brehaut has left Granby Consolidated at Anyox, B. C., to join the staff of Seal Harbour Gold Mines, in Nova Scotia.

C. B. Dawson, consulting mining engineer and geologist, has opened an office at 401 Hamilton Building, 395 Main St., Winnipeg, Canada.

J. B. Kasey is now connected with the Hudson Smelting & Refining Company, in Newark, N. J., as metallurgist and plant chemist.

J. L. Ramsell has been appointed resident manager of McKenzie Red Lake gold mine, at McKenzie Island, in the Red Lake district of northern Ontario.

Colin Fraser, managing director of Broken Hill Associated Smelters and a director of a number of important gold-mining companies, was created a Knight Bachelor at the beginning of January.

Ralph D. Parker has been appointed general superintendent of the mining and smelting division of The International Nickel Company at Copper Cliff, Ontario.

Enoch Perkins, general manager of the chrome-ore mines of the Mutual Chemical Company of America in New Caledonia, has returned to New York after a prolonged visit to the mines.

Ray Nolan, formerly employed by Butler Brothers, succeeded **R. J. Moore** as chief engineer of State mines of Minnesota on Feb. 15. Mr. Moore had been chief engineer for 25 years.

F. O. Bacon, Jr., formerly assayer and chemist for the Tombstone Development Company, at Tombstone, Ariz., is now mill superintendent with La Mexicana y Anexas Company at Guanacevi, Durango, Mexico.

R. E. Charles, who has spent the past year and a half on prospecting and exploration work in the Huizopa district of Chihuahua, Mexico, for the Heimpel Investment Company, has returned to the United States and is at his home in Salina, Kan.

Heath Steele, vice-president of the American Metal Company, recently left New York City to visit the company's properties in the Southwestern part of the United States and Mexico. He will return to the company's New York headquarters at the end of March.

V. H. Emery, consulting engineer for Kirkland Lake Gold Mines, has assumed the position of managing director of the company, succeeding **Dr. J. B. Tyrrell,** resigned. Dr. Tyrrell had been president and managing director of the company for the last five years.

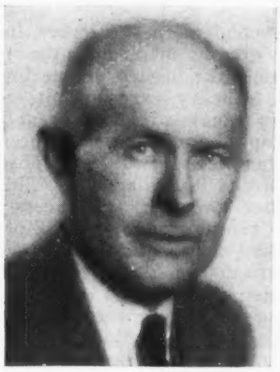
Dr. H. J. Fraser, of the department of geological research of The International Nickel Company of Canada, Ltd., is spending some months in Professor Graton's laboratory at Harvard on special microscopical investigations of the Sudbury ores.

Dr. Thomas Arthur Rickard, formerly editor of *Mining and Scientific Press* and of *Engineering and Mining Journal,* has been

Dr. Rickard

awarded a certificate of honorary member of the Institute in recognition of "his outstanding achievement as a proponent and preceptor of advanced standards in technical concept and writing."

S. Power Warren, professor of metallurgy, and for several years a member of the faculty of the Colorado School of Mines, has resigned from the teaching



S. Power Warren

staff of the University to take up consultation work on the Pacific Coast. His headquarters will be at Auburn, Calif.

Arthur D. Davis has resigned his position with the American Smelting & Refining Company at Catorce, S. L. P., Mexico, where he has been in charge of operations, to accept the position of mine superintendent with the San Luis Mining Company at Tayoltita, Durango.

E. G. Lawford, of the technical staff of Rio Tinto Company, Ltd., and formerly an assistant editor of *Engineering and Mining Journal,* is in the United States on a short business trip. He expects to return to London at the end of March.

H. W. Kaanta, consulting engineer in milling, non-ferrous industries, for the U. S. S. R., is in the United States on a three months' leave of absence after spending seven years in Russia. He can be reached at 441 South Ogden St., Denver, Colo.

John A. Agnew left London on Feb. 16 for South Africa. Though he has visited most of the other gold-mining districts of the world, and is chairman of Consolidated Gold Fields of South Africa, this will be Mr. Agnew's first visit to the Rand.

Alan Probert has left the United States Smelting, Refining & Mining Company, where he served as mill superintendent, first at the company's Sunnyside plant, at Eureka, Colo., and later in the same capacity at the Midvale (Utah) mill, and more recently as superintendent of the Midvale lead refinery, to become associated as metallurgical engineer at the Booth-Thompson division of the Galigher Company, of Salt Lake City.

OBITUARY

R. Home Smith, long prominently identified with mining in Canada, died on Feb. 4. He was 57 years old.

George Lerch, one of the firm of Lerch Brothers, who have done much of the iron-ore analysis of the Mesabi range for many years, died on Jan. 28 at the age of 69. Mr. Lerch was one of the pioneers of the Mesabi.

Cecil B. Rowe, superintendent of the San Rafael mine of the Cia. Minera San Rafael y Anexas, S. A., at Pachuca, Hidalgo, was killed when his automobile jumped the road in turning a curve a few miles from Pachuca. Mr. Rowe was born in Cornwall, England, but had lived in Mexico for many years.

Charles A. Randall, Kirkland Lake's pioneer metallurgical engineer, died at Kirkland Lake, Ontario, on Jan. 30. Mr. Randall was a member of the Canadian Institute of Mining and Metallurgy, Kirkland Lake Branch, and of the American Institute of Mining and Metallurgical Engineers.

Ignacio Reynoso, an engineer employed by the Guanajuato Reduction, Milling & Mining Company, at Guanajuato, Guanajuato, died there recently of a heart ailment said to have resulted from shock at witnessing the death of a friend in an accident some time ago in the company's Bustos mine.

Oscar J. Frost, a resident of Denver, Colo., for 53 years, died on Feb. 5. Mr. Frost was born in Almond, Wis., in 1859. Within a week of his graduation from the University of Wisconsin in 1882 he went into the laboratory of the old Boston & Colorado Smelter, at Argo, where he remained for five years. At this time he was the Colorado representative of *Engineering and Mining Journal.*

Wade Anton Siebenthal died at his home in Tucson, Ariz., on Feb. 15. He was assigned by the United States Government to survey and develop manganese mines during the World War. He was placed in charge of production of manganese for steel companies at Philipsburg, Mont. Mr. Siebenthal had also served as mines superintendent for Cambria Midvale Steel and as safety engineer for Phelps Dodge at Morenci.

Dr. David White, senior geologist of the United States Geological Survey, died on Feb. 7 in Washington, D. C. He was 72 years old. A native of Palmyra, N. Y., and an alumnus of Cornell University, he came to the Geological Survey in 1886 and had been associated with this scientific branch of the Government ever since. For the past few years Dr. White had been engaged primarily in studying evidences of the earliest traces of life on earth. One of the latest and most extensive of Dr. White's works was undertaken in the Grand Canyon in cooperation with the Carnegie Institution. For his work on ancient life traces he recently received the Walcott Award of the National Academy of Sciences.

Dr. C. C. O'Harra

Dr. C. C. O'Harra, 68, president of the South Dakota State School of Mines, distinguished educator, writer, and geologist, died at his home in Rapid City, S. Dak., on Feb. 21. He was a graduate of Carthage College, where he served as vice-president from 1893-1895, after which he studied at Johns Hopkins University. He was a fellow of the Geological Society of America and of the American Association for the Advancement of Science; a member of the American Institute of Mining and Metallurgical Engineers since 1903; member of the Society for the Promotion of Engineering Education; corresponding member of the Geological Society of Washington, and member of the Seismological Society of America.

The Tax Burden in Colombia

The Editor:

Production of gold in the Republic of Colombia has been steadily increasing over the past several years, and a further substantial increase was recorded in 1934, as indicated by the following statistics published by the Colombian Government and the Bank of the Republic:

Year	Fine Ounces	Year	Fine Ounces
1929	136,576	1932	248,249
1930	158,732	1933	298,242
1931	194,274	1934	344,140

This increase in production took place notwithstanding many factors adverse to the industry, especially to foreign capital investments. All gold has to be sold to the government bank, the Bank of the Republic, and as a strict control of exchange has limited remittances abroad by foreign mining companies to 40 per cent of the value of the gold, such companies have been faced with the problems of "blocked" pesos in Colombia. Since April, 1933, the price in pesos paid for gold by the Bank of the Republic has usually been the equivalent of from $1.50 to $3 per ounce below the world price. Income taxes bore especially heavily on mining companies, because no deduction was permitted for depletion; and though theoretically, under the law, a deduction was permissible for depreciation, in practice, due to the attitude of the tax authorities, this provision was in effect nugatory.

New and drastically increased taxation provided for by two decrees issued on Dec. 28 and Dec. 29, 1934, by the President under his emergency war powers, notwithstanding that the Congress was in session, has caused much protest among Colombian mining interests.

The first of these decrees imposes a tax of one-half of 1 per cent on the estimated capital in Colombia as of Dec. 31, 1934, of every person and company, national or foreign, resident or non-resident, having property or doing business in Colombia, and irrespective of whether the property is productive or not or whether the business shows a profit or a loss.

The second of these decrees, in addition to greatly increasing the income tax rates in the higher-income brackets, imposes a heavy excess-profits tax on profits in excess of 12 per cent on invested capital and reserves. The former income-tax law of 1931 imposed no excess-profits tax whatsoever. The present decree provides for excess-profits taxes on profits in excess of 12 per cent on invested capital and reserves, at rates ranging from 10 per cent to 30 per cent. The latter rate applies on all profits exceeding 50 per cent of the invested capital and reserves. Both the increased income tax and the excess-profits tax are retroactive to income for 1934, the excess-profits tax being based on the capital of the taxpayer as at Dec. 31, 1933.

The new income-tax rates range from 1 per cent on incomes of 2,000 pesos up to 16 per cent on incomes in excess of 500,000 pesos. On incomes of from 200,000 to 300,000 pesos, the rate is 13 per cent; from 300,000 to 400,000, 14 per cent; from 400,000 to 500,000, 15 per cent. Under the old law, the highest rate was 8 per cent, which applied on incomes in excess of 250,000 pesos.

These taxes will in effect take a very large share of the real profits of mining companies; inasmuch as no deduction for depletion is allowed, the provision for depreciation, in the light of past practice, may be of little benefit, and certain other deductions formerly permitted by the law are partly or completely eliminated.

Losses or damage arising from fire, storm, theft, and other fortuitous events not compensated by insurance were deductible under provisions of the previous law, but these provisions are eliminated in the new decree. In addition, only 20 per cent of the payments made to doctors, lawyers, and engineers, instead of the whole amount, is deductible; these items are especially heavy in the case of foreign mining companies. Payments made abroad for interest, head-office expenses, salaries, and engineering services are also not deductible, unless the Colombian income tax on these payments is retained and paid on behalf of the recipient thereof.

These new decrees in practice not only tend to burden mining companies relatively much more than other businesses, but disregard completely the fact that mines are wasting assets, and that a great deal of prospecting and development work is carried on at great expense, often with negative results. The fact that these expenditures are undertaken only in the hope of deriving exceptional profits from the rare cases where a paying property results, is entirely lost sight of. In the case of established companies, it would appear probable that operating programs might be modified, to the prejudice of the total mining production of the country.

Unquestionably, it is the increased gold production in the past two or three years that has been one of the chief factors in the steady emergence that Colombia has been making out of the depression. This gold production undoubtedly also has been an important element in maintaining the relative stability of her currency and in enabling her to finance the heavy military expenditures for preparation against a war with Peru. With this threat of war removed and the cessation of the heavy military expenses, Colombia would seem ready to enter upon a new era of prosperity. It would appear decidedly to the best interest of Colombia for the government to do everything within its power to encourage the mining industry, and particularly the investment in it of foreign capital, which is essential to the full development of the mineral resources of the country. The new taxation appears to be decidedly a step in the opposite direction. A SUBSCRIBER.

A Correction

The Editor:

We call your attention to an error in the article, "Corduroy as a Gold Saver," by M. W. von Bernewitz, in your January, 1935, issue. The author erroneously states that James Johnson is represented in the United States by the American Cyanamid Company. This is incorrect, as we have the selling rights for the whole of North America, including Mexico. We have appointed the National Equipment Company, 101 West Second Avenue South, Salt Lake City, Utah, to represent us in the territory West of the Mississippi River.

PEACOCK BROTHERS LIMITED.
Montreal, Canada.

NEW BOOKS

South America's Resources

ORES AND INDUSTRY IN SOUTH AMERICA. *By H. Foster Bain and Thomas Thornton Read. Harper & Brothers, 1934. Pp. 381. Price $3.50.*

This is a valuable book for the business man who wants the facts on actual and potential resources of South America, for the economist who needs a broad-gage view of foreign trade balances now and over the future for the individual countries considered, and for the engineer who requires intimate information on particular mineral resources of South America from acknowledged authorities on the subject. The authors need no introduction to the engineering profession. Their contributions to the technical literature, and their employment as expert advisors to several of the South American States, permit their volume to be classed as a standard work of reference and a welcome addition to the engineering library.

The lay reader will no doubt be most interested in the first two chapters on general aspects of the problem, the land and the people, and the final chapter, "What of the Future?" Contrary to the popular belief too generally held, that South America is a country of limitless undeveloped possibilities, destined to become one of the great industrial regions of the world, the authors, as a result of painstaking and fair analysis of the individual countries, their resources and economic development, conclude that the continent for some time to come is destined to remain in its past rôle of exporter of minerals either in the raw or simply processed state. "South America," they add, "is indeed a continent with a future, but not a spectacular one in industry. On the whole the world may expect the development to be slow and along existing lines."

As might be expected from the work of the senior author, the geological discussions under each country are comprehensive and of great value to the engineer who may require the broad outlines for a special problem. As emphasis is laid upon oil resources of Colombia, Venezuela, Peru, and Argentina, the discussion of the structural geology in these areas is presented in detail and is of especial interest to the petroleum engineer. The authors point out that the sole basis for belief in extraordinary returns on capital investment in South America lies in the possible future discovery of petroleum in large quantities in the immense area lying east of the Andes. For all the other minerals they assert that the cost of producing such as exist has so far left but moderate returns to those responsible for their development.

Such subjects as copper, iron, and nitrate in Chile, and the development of Cerro de Pasco in Peru, of St. John del Rey in Minas Geraes, and of Patiño in Bolivia, are covered not only in engineering detail but with a wealth of new information gleaned from personal experiences of the authors in these areas, which add much to the value of their observations. It is unfortunate that the book does not contain adequate maps, so that the location of such prominent mines as Chuquicamata, Braden, Andes, Cerro, Patiño, and others referred to in the text could be readily found. If a single criticism must be leveled at the volume, it is the lack of legible, well-prepared maps that would do so much to clarify a page of description. WILLIAM F. BOERICKE.

An Active Organization

TRANSACTIONS OF THE AMERICAN GEOPHYSICAL UNION. Fifteenth Annual Meeting, 1934. *Published by National Research Council of the National Academy of Sciences. Washington, D. C. June, 1934. Two Parts. Pp. 633. Price $2.75.*

These volumes contain the papers and reports presented at the annual meetings, held at Washington, D. C., and Berkeley, Calif. Part I (pp. 1-259) contains the transactions of the General Assembly and of the sections of Geodesy, Meteorology, Terrestrial Magnetism and Electricity, Oceanography, and Volcanology. Part II (pp. 260-633) is devoted to papers and reports of the Section on Hydrology.

These two volumes, taken alone, are significant chiefly as a part of a series issued annually. The importance in the field of pure science and of engineering of the growth of the American Geophysical Union is, however, hard to overestimate. This body, which is a semi-government organization, was organized in 1919 as the American Committee of the International Union of Geodesy and Geophysics. As indicated in the outline of proceedings given in the foregoing, its activities embrace the whole field of earth physics. Its membership, which is large and rapidly increasing, is drawn from every branch of earth science and engineering. This wide range of training and ability applied cooperatively to earth problems has resulted in new points of view and new methods of attack.

I have been following the activities of this organization for several years. Its vitality and breadth of scope and method render it, in my opinion, one of the most important organizations in the domain of earth science. One interested scientifically or from an engineering standpoint in physical earth problems of all sorts and kinds would do well to have access to this series in his reference library. M. KING HUBBERT.

Publications Received

Investigation in Ore Dressing and Metallurgy, January to June, 1933. Mines Branch, Department of Mines, Ottawa, Canada. Bulletin 743. Pp. 157.

Twenty Questions on the Economic Security of the People—A Study Outline. Published by the Association Press, 347 Madison Ave., New York City. Price 25c.

Geology of the Country Around Filabusi, Insiza District. By J. C. Ferguson. Geological Survey Bulletin No. 27. Salisbury, Southern Rhodesia. Pp. 179. Price 5s., foreign postage 4d. extra.

James Furman Kemp, Biographical Memoir. By Frank Dawson Adams. National Academy of Sciences, Washington, D. C. Pp. 21.

Slocan Mining Camp, British Columbia. Memoir 173, Dominion Geological Survey. By C. E. Cairnes, Department of Mines, Ottawa. Pp. 137. Price 50c.

Hints to Prospectors and Owners of Treatment Plants. Royal Mint, Perth, Western Australia. Copies from the Government Printer, Perth. Pp. 64. Price, 9d., post free (in Australia).

Neuere Chemische Analysen von Finnischen Gesteinen. By Lauri Lokka. Bulletin of the Geological Commission of Finland. No. 105. Helsingfors. Pp. 70.

Index to A.S.T.M. Standards and Tentative Standards. Jan. 1, 1935. American Society for Testing Materials, Philadelphia. Pp. 142.

Assay of Black Sands. By Paul Hopkins. United States Bureau of Mines, Report of Investigations 3265. Washington, D. C. Pp. 5.

Waste Filling of Stopes. By C. F. Jackson. Information Circular 6916. U. S. Bureau of Mines, Washington, D. C. Pp. 25.

Bario (Barium). By Othon Henry Leonardos. Separate No. 2, National Department of Mineral Production, Rio de Janeiro, Brazil. Pp. 20.

Studies in Zinc Metallurgy. By H. A. Doerner, G. L. Oldright, T. B. Brighton, and C. L. Dice. Report of Investigation 3256, U. S. Bureau of Mines, Washington, D. C. Pp. 43, mimeographed, plus plates.

Smelting in the Lead Blast Furnace—Handling Zinckiferous Charges, Parts XI, XII, XIII, XIV, and XV. G. L. Oldright and Virgil Miller. Reports of Investigations 3243-44-45-46 and 3264 respectively, U. S. Bureau of Mines, Washington, D. C.

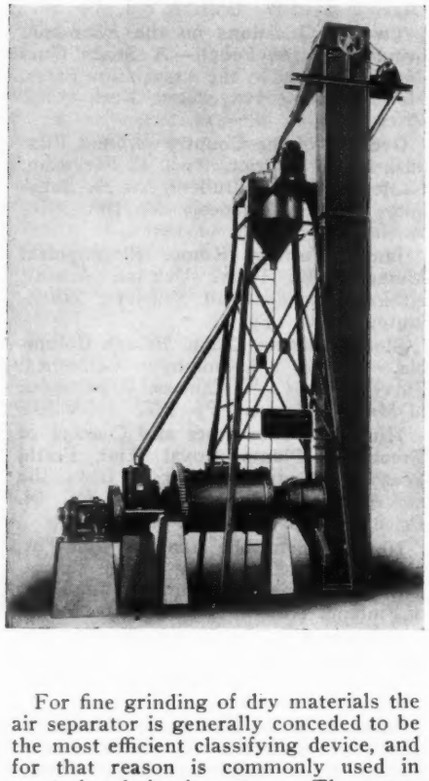
The Saragura and Associated Gold Occurrences of the Mwanza Area. By F. B. Wade. With Petrographical Notes on the Specimens Collected, by F. Oates. Short Paper No. 12. Geological Survey Department, Dar es Salaam, Tanganyika Territory.

Annual Report for Chief Inspector of Mines in India, 1933. Delhi, India. Pp. 172. Price, 3c. 6d.

EQUIPMENT NEWS

A Portable Closed-circuit Dry-grinding System

Its Capacity Is 100 Lb. to 1 Ton per Hour



For fine grinding of dry materials the air separator is generally conceded to be the most efficient classifying device, and for that reason is commonly used in most closed-circuit systems. These systems are adjustable so that they may be easily changed from one mesh to another within a few minutes. Hence if several products of varying finenesses are desired it is possible to change from, say, 98 per cent through 150 mesh to 98 per cent through 200 mesh by simple adjustments, and to make the change in a few moments.

Closed-circuit, dry-grinding systems have in the past been confined largely to units of large size and almost invariably to units where an output of 1 ton or more per hour is desired. The unit shown in the accompanying illustration is intended for installation where the desired output is from 100 lb. to 1 ton per hour. This system is practically self-contained, requiring foundation for mill and motor only, the framework supporting the elevator, separator, and other equipment. It is, in a general sense, a portable outfit and may easily be moved when so desired. It is a product of the Patterson Foundry & Machine Company, East Liverpool, Ohio.

The outfit consists of the conventional ball or tube mill with scoop or other feeding device completely enclosed and dust-tight. The connection between the mill and the elevator is also dust-tight and a novel device removes broken pebbles or balls, separates them from the product, and discharges them automatically. The mill is motor-driven. The separator is motor-driven with a Unipower drive, both separator and drive being carried by the framework of the outfit. The entire unit is absolutely dust-tight.

This Vibrating Screen for Sizing Fine Materials Accurately

A new vibrating screen designed to size fine materials accurately and having a uniform motion, an instant angle adjustment, as well as self-absorbed vibration and a construction which permits mounting on horizontal or inclined supports or by cable suspension, has been developed by the Robins Conveying Belt Company, of New York. The features claimed for it include substantial construction, no rivets being used in the heavy steel frame, but all connections being either welded or bolted; protection of moving parts by a cast alloy tube and a steel drum housing; quick and easy slope adjustment, achieved by loosening two bolts on each side of the screen; a simple method of changing the cloth, involving only the slackening of the tensioning bolts and the substituting of a new panel for the old; high capacity attained by virtue of the uniform circle-throw action over the entire screening surface; low power requirements, varying with screen size but not exceeding that of a 3 hp. motor; and controlled vibration, effected by a simple adjustment of the unbalanced weights. Vibration of the screen is absorbed by four heavy coil springs so that it is not transmitted in any degree to the supporting structures.

This screen is to be had in six sizes, for floor mounting or suspension, with or without dust covers, and in single or double deck. It is standardized in widths of 3 and 4 ft. and in lengths of 6½ or 8½ ft., single or double deck, or in 10 ft. lengths, single deck only. The vibrator shaft runs at 1,800 r.p.m.

For Haulage Service At Plant and Mine

A new series of industrial geared locomotives, driven by gasoline or diesel engine and ranging in capacity from 2½ to 25 tons, has been introduced by the Davenport Locomotive Works of the Davenport Besler Corporation, Davenport, Iowa. These locomotives have a wide range of speeds and can develop maximum hauling power at speeds as low as 2½ to 3 miles per hour. Cabs are provided with convenient controls and instrument panels. On all sizes up to 12 tons hand-lever-type brakes are standard. Air brakes are optional on the 7- to 12-ton sizes and are standard equipment on the 15- and 25-ton locomotives.

Improved Transformer Bushing Seep-proof, Gas-tight

Improved dry-type apparatus bushings for lower distribution voltages have been developed by Ohio Brass Company, Mansfield, Ohio. Oil seepage of dry-type bushings on conservator-type transformers, according to the company, was a problem in bushing construction which had never been satisfactorily solved. Under the pressure of a head of oil, such bushings of this type were subject to seepage. In the company's new Class R bushings this problem has been solved by use of a new method of assembly at the flange line of the bushing, and by employing a bronze insert at the top, which is ground to a true flat surface. A cork gasket held in constant compression between the lower porcelain weathershed and metal mounting flange is inserted. Thus these new bushings, which are illustrated below, are seep-proof and gas-tight.

Goggles for Hot or Humid Working Places

Those who work in confined spaces or where the temperature or humidity is high should welcome the "Duralite-50 Hot Workers' Goggle" just announced by American Optical Company, Southbridge, Mass. This new goggle practically doubles the area usually allowed for ventilation. The extra ventilation back of the lenses keeps them free from fogging and steaming, also keeps the area around the eyes cool, and so prevents perspiration from obscuring the vision. Hazards of stumbling, falling, or colliding with objects because of fogged lenses are thus eliminated. The goggles also provide dependable eye protection. They are shown above.

New Monel Metal With Strength Of Alloy Steel

Engineers of the International Nickel Company have produced a new type of Monel metal known as K Monel, which combines the strength of alloy steels with the corrosion resistance of regular Monel metal. In analysis the new alloy is practically the same as the latter save for the addition of about 4 per cent of aluminum and fractional amounts of other elements. It is readily heat-treated and in fully hardened condition shows Brinell values above 350, though it is available also in softer forms. Its tensile strength runs higher than 160,000 lb. a square inch.

A High-lift Centrifugal Pump

Development of a pump specially designed for extremely high lifts or a high-pressure water supply has been announced by the Byron Jackson Company, Berkeley, Calif. Known as the Hydropress, it embodies the proved principle of centrifugal pumps and permits the building of pressures up to 2,800 lb. The number of stages used, ranging from 4 to 54, depends upon conditions. Pump capacity ranges from 10 to 250 gal. per minute. Four standard sizes are available—8, 10, 12, and 15 in. This pump is said to be especially dapted to mining service.

Respirator of High Filtering Efficiency

An improved dust respirator, Model M-15, has been developed by the Pulmosan Safety Equipment Corporation, Brooklyn, N. Y. It is recommended for protecting workers against the dusts from quartz, asbestos, iron ores, cement, limestone, gypsum, coal, coke, charcoal, wood, and aluminum. It is said to be effective in the severest concentrations of these dusts.

Industrial Notes

S. E. Stein, formerly with the Southwestern Engineering Corporation, has joined the staff of the reorganized firm, Southwestern Engineering Company. E. R. Cullity, with whom he was associated in the old company, is now manager of the mining department of the new concern.

Allis-Chalmers Manufacturing Company, Milwaukee, Wis., announces that it has filed suit in the District Court of the United States, Northern District of Texas, Fort Worth Division, against the Fort Worth Steel & Machinery Company for infringement of Geist patent No. 1,662,511, covering the multiple rubber V-belt drive.

Worthington Pump & Machinery Corporation, Harrison, N. J., has consolidated several of its contributing sales divisions into one mining and construction department, under the management of W. A. Neill, with headquarters at Harrison.

Phelps Dodge Corporation has sold one of its fabricating subsidiaries, the National Electric Products Corporation, to W. C. Robinson and associates, of Pittsburgh. The National Electric Company is a successor to National Metal Molding Company, with a plant at Ambridge, Pa. Phelps Dodge retains as its fabricating subsidiary, Phelps Dodge Copper Products Corporation, which was formed through the consolidation of American Copper Products Corporation, British American Tube Company, P-M-G Metal Company, Habirshaw Cable & Wire Corporation, and Inca Manufacturing Company. At one time the entire fabricating business of Phelps Dodge was concentrated in one company under the name of National Electric Products Corporation. Early in 1932, however, the business was separated into two companies, operated separately—namely, National Electric Products Corporation, fabricating primarily steel conduit; and Phelps Dodge Copper Products Corporation, fabricating copper products. Phelps Dodge has found that conduit and allied steel products do not fit in with its copper business and therefore sold back to Mr. Robinson and his associate the National Electric Products Corporation, consisting of the old National Metal Molding Company, with a plant at Ambridge.

Manhattan Rubber Manufacturing Division of Raybestos-Manhattan, Inc., Passaic, N. J., announces that a United States patent has been granted it covering its Condor compensated belt.

Bulletins

Chains, Sprockets and Buckets. C. O. Bartlett & Snow Co., Cleveland, Ohio. Bulletin 74.

Pneumatic Tools. Ingersoll-Rand Co., 11 Broadway, New York. Bulletin entitled "The World's Most Popular Pneumatic Tools." Pp. 8.

Card-Timken Roller-Bearing Truck. C. S. Card Iron Works Co., Denver, Colo. Folder.

Plug and Feather Drill. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin No. 211, describing a drill for plug and feather holes for wedge break-up of large granite blocks. Pp. 4.

Gyratory Crushers. Traylor Engineering & Mfg. Co., Allentown, Pa. Circular entitled "For Worthwhile Efficiency, Bell-Shaped Crushing Heads Must Be Used With Curved Concaves." Pp. 4.

Silico-Manganese Spring Steel. Bethlehem Steel Co., Bethlehem, Pa. Folder 305. Pp. 4.

Heat-treated Forgings. Kropp Forge Co., Chicago, Ill. Bulletin covering forgings made to specifications. Pp. 4.

Wire Rope. Broderick & Bascom Rope Co., St. Louis, Mo. Booklet entitled "What You Should Know About 'Flex-Set' Preformed Yellow Strand Wire Rope." Pp. 20.

Crushers. Hadfields, Ltd., Sheffield, England. Folder on heavy-duty sledging breaker. Pp. 6.

Valves. Homestead Valve Manufacturing Co., Coraopolis, Pa. Reference Book No. 37, covering full line of valves.

Portable Electric Tools. Skilsaw, Inc., 3310 Elston Ave., Chicago. Circular on bench and pedestal grinders and combination grinder-buffers, bench and pedestal type. Pp. 2.

Cyanidation. The Merrill Co., 343 Sansome St., San Francisco, Calif. Folder covering the Merrill-Crowe precipitation process (simultaneous clarification, precipitation).

Steam Power Plant. Combustion Engineering Co., Inc., 200 Madison Ave., New York. Catalog No. E-8, on the Type E, center-retort, underfeed stoker. Pp. 16.

Gold Concentration. Spicon Co., 417 South Hill St., Los Angeles, Calif. The Spiro concentrator. Pp. 4.

Air-Cooled Transformers. General Electric Co., Schenectady, N. Y. Bulletin GEA-897E, on transformers for lighting and power service. Pp. 18.

Manganese Steel. American Manganese Steel Co., Chicago Heights, Ill. The *Amsco Bulletin*, containing "The Story of Manganese Steel." Pp. 12.

Refractories. General Refractories Co., Philadelphia, Pa. Nine booklets: One entitled "Refractory Products and Service"; four on company products—namely, fireclay brick, plastic firebrick, chrome-base high-temperature cement (Grefco), and fireclay and cyanite-base high-temperature cements (Briklok and G. R. Co.); three on important fields and uses—namely, boiler plants, metallurgical processes, and rock-products industries; also one on refractories produced in the company's Southern plant, called "High Grade Refractories From the South."

Industrial Diamonds. Anton Smit & Co., 24 State St., New York. Leaflet entitled "The Romance of Industrial Diamonds." Pp. 4.

Valves for Corrosive Service. Lunkenheimer Co., Cincinnati, Ohio. Bulletin F592. "Causul" Metal Gate Valves.

Steel Flooring, Stair Treads. Illinois Steel Co., Chicago, Ill. Multigrip floor plate for anti-skid surfaces. Pp. 4.

Protection From Carbon Monoxide. Mine Safety Appliances Co., Pittsburgh, Pa. Bulletin entitled "Carbon Monoxide, the Killer." Pp. 20.

Centrifugal Pumps. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin W-318-B4 on Type UC three-stage volute pumps; Bulletin W-321-B3 on Monobloc centrifugal pumps. Pp. 4. Also Bulletin W-321-B4 on Monobloc centrifugal pumps, Types DE, DF, and DG. Pp. 4.

Construction Steel. Bethlehem Steel Co., Bethlehem, Pa. Booklet No. 78. Bethlehem Light Sections. Pp. 15.

Diesel Engines. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin S-500-B6D. Vertical four-cycle direct-injection engines. Pp. 16.

Mercury Arc Rectifiers. Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Bulletin 1168. Rectifiers for power conversion in electrolytic plants.

Explosives, Blasting Accessories. Atlas Powder Co., Wilmington, Del. Catalog. Pp. 32.

SUMMARY OF

MONTHLY COMMENT . . . DAILY AND AVERAGE MONTHLY

THOUGH the industrial pace seemed to slacken moderately in February, compared with the first month of the year, purchases of copper, lead, and zinc increased. Prices were irregular, firming toward the close on prospects of curtailing foreign output of copper as well as domestic production of zinc. Gold made a new high in the London market. Silver in New York settled at 56½c. (open market quotation), the highest price since March, 1929. Our weighted index number of non-ferrous metal prices for February was 69.97, against 70.43 in January, and 67.45 in February, 1934. Monthly averages for lead, zinc, and tin were lower, which more than offset a rise in silver.

Late in February it was announced that copper producers would meet in New York early in March to discuss stabilizing the market outside of the United States. This development was accepted as signifying that producers had made considerable progress at the preliminary conversations and that an agreement, at least on production control, is probable.

Sales of "Blue Eagle" copper in the domestic market during February totaled about 29,500 tons, which compares with 27,000 tons in January, and 19,500 tons in December. The price continued at 9c., Valley. Nothing is expected in the way of a price revision here until after the foreign situation becomes more settled.

Prime Western zinc advanced to 3.825c., St. Louis, on news to the effect that output would be curtailed in March and an earnest attempt made at balancing production and consumption.

Stocks of refined lead in the United States at the beginning of February totaled 231,993 tons, a decrease of 3,646 tons from the amount on hand a month previous. The price was regarded as steady as February came to a close.

The failure of three commodity houses in London brought out some unfavorable comment on the tin control plan. It was revealed that an unofficial pool had been operating in tin and this news, together with some forced selling, sent the price sharply lower. Standard tin in London fell to £214 15s. spot, on Feb. 26, with the three-months' position down to £212 10s. United States deliveries during February totaled 3,905 long tons, against 4,600 tons in January.

Settlement of the gold-clause cases by a five-to-four decision upholding the Government had little influence on the markets. The Supreme Court's decision was announced Feb. 18.

United States Market

	Electrolytic Copper			Straits Tin	Lead		Zinc
	Domestic		Export	New York	New York	St. Louis	St. Louis
Feb.	(a)	(b)	(c)				
1	9.00	8.775	6.425	51.100	3.50	3.35	3.70
2	9.00	8.775	6.425	51.100	3.50	3.35	3.70
4	9.00	8.775	6.400	51.100	3.50	3.35	3.70
5	9.00	8.775	6.375	51.125	3.50	3.35	3.70
6	9.00	8.775	6.350	51.125	3.50	3.35	3.70
7	9.00	8.775	6.350	51.200	3.50	3.35	3.70
8	9.00	8.775	6.325	51.100	3.50	3.35	3.70
9	9.00	8.775	6.350	51.100	3.50	3.35	3.70
11	9.00	8.775	6.375	50.750	3.50	3.35	3.70
12	9.00	8.775	6.375	50.625	3.50	3.35	3.70
13	9.00	8.775	6.375	50.375	3.55	3.40	3.70
14	9.00	8.775	6.350	49.850	3.55	3.40	3.70
15	9.00	8.775	6.350	50.000	3.55	3.40	3.70
16	9.00	8.775	6.350	50.050	3.55	3.40	3.70
18	9.00	8.775	6.350	50.450	3.55	3.40	3.70
19	9.00	8.775	6.400	50.375	3.55	3.40	3.70
20	9.00	8.775	6.375	50.175	3.55	3.40	3.70
21	9.00	8.775	6.350	50.000	3.55	3.40	3.70
22	9.00	8.775	6.275	Holiday			
23	9.00	8.775	6.250	49.200	3.55	3.40	3.70
25	9.00	8.775	6.150	48.100	3.55	3.40	3.75
26	9.00	8.775	6.150	47.625	3.55	3.40	3.75
27	9.00	8.775	6.325	47.575	3.55	3.40	3.80
28	9.00	8.775	6.375	47.350	3.55	3.40	3.80@3.85
Av. for month	9.00	8.775	6.341	50.063	3.528	3.378	3.714
Averages for Week							
6		8.775	6.396	51.108	3.517	3.367	3.700
13		8.775	6.358	50.858	3.508	3.358	3.700
20		8.775	6.363	50.150	3.550	3.400	3.700
27		8.775	6.250	48.500	3.550	3.400	3.740
Calendar Week Averages							
2		8.775	6.433	50.992	3.600	3.450	3.700
9		8.775	6.358	51.125	3.500	3.350	3.700
16		8.775	6.363	50.275	3.533	3.383	3.700
23		8.775	6.333	50.040	3.550	3.400	3.700

Silver, Gold, and Sterling Exchange New York and London

	Sterling Exchange		Silver		Gold	
		"90-day	(d)			(e) United
Feb.	"Checks"	Demand"	New York	London	London	States
1	4.86875	4.86625	53.5000	24.3125	142s 4 d	$35.00
2	4.87000	4.86750	53.5000	24.3125	142s	35.00
4	4.87125	4.86875	53.8750	24.4375	142s 1 d	35.00
5	4.88000	4.87875	53.8750	24.4375	142s 1½d	35.00
6	4.88375	4.88125	53.7500	24.3125	141s10½d	35.00
7	4.88000	4.87750	53.8750	24.3750	142s 1 d	35.00
8	4.87750	4.87625	53.8750	24.4375	142s 1½d	35.00
9	4.88000	4.87875	53.8750	24.4375	142s 2½d	35.00
11	4.88125	4.88000	53.8750	24.4375	142s 3½d	35.00
12	Holiday			24.4375	142s 2½d	Holiday
13	4.87750	4.87625	53.8750	24.4375	142s 4 d	35.00
14	4.87875	4.87750	54.3750	24.6250	142s 6½d	35.00
15	4.87375	4.87250	54.7500	24.8125	142s 8½d	35.00
16	4.87000	4.86750	54.7500	24.9375	142s 8½d	35.00
18	4.86500	4.86250	54.7500	24.8125	142s 7 d	35.00
19	4.88500	4.88375	55.2500	25.0000	142s10 d	35.00
20	4.88500	4.88375	55.2500	25.1250	142s 9½d	35.00
21	4.88000	4.87875	55.2500	25.1875	142s11 d	35.00
22	Holiday			25.1250	143s 6½d	Holiday
23	4.86125	4.85875	55.3750	25.2500	143s11 d	35.00
25	4.86125	4.85750	55.3750	25.5000	143s 9½d	35.00
26	4.86250	4.85875	55.5000	25.5625	143s 6½d	35.00
27	4.85875	4.85500	56.2500	25.6250	143s11½d	35.00
28	4.85000	4.84625	56.5000	25.6875	144s 1 d	35.00
Av. for month	4.87278	.....	54.602	24.818	.....	35.00
Averages for Week						
6	4.87396	.....	53.729	.....	.....	.....
13	4.87925	.....	53.875	.....	.....	.....
20	4.87625	.....	54.854	.....	.....	.....
27	4.86475	.....	55.550	.....	.....	.....

Calendar week averages: New York Silver, Feb. 2d, 53.979; 9th, 53.854; 16th, 54.325; 23d, 55.175.

(a) Quotation issued by the Code Authority for copper offered for sale in the domestic market pursuant to the provisions of the Copper Code.

(b) Net prices at refineries on the Atlantic seaboard, being Code Authority prices, less delivery and interest charges of 0.225c. per lb. which is the average differential for delivery in New England.

(c) Export quotations for copper are net prices at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. The c.i.f. Hamburg, Havre, and Liverpool basis commands a premium of 0.300c. per lb. above our f.o.b. refinery quotation.

Excepting "Blue Eagle" copper, the above quotations are our appraisal of the major United States markets, based on sales reported by producers and agencies. All prices are in cents per pound.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is quoted at 0.35c. per pound above St. Louis, this being the freight differential. Contract prices for High-Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(d) Silver other than newly mined domestic. Under Executive order issued Dec. 21, 1933, the U. S. Government price on newly mined domestic silver was established at 64½c. per troy ounce.

(e) U. S. Treasury's gold price.

THE MARKETS

PRICES OF METALS . . . MISCELLANEOUS QUOTATIONS

London Market

	Copper			Tin, Standard		Lead		Zinc	
	Standard		Electrolytic						
Feb.	Spot	3M	Bid	Spot	3M	Spot	3M	Spot	3M
1	27.7500	28.0000	30.7500	233.7500	228.8750	10.1250	10.4375	11.7500	12.0625
4	27.5625	27.8750	30.5000	233.5000	228.8750	10.1875	10.4375	11.8125	12.0625
5	27.2500	27.5000	30.2500	233.0000	228.8750	10.0625	10.3125	11.8125	12.0625
6	27.1250	27.3750	30.2500	232.7500	228.8750	10.0625	10.3125	11.7500	12.0000
7	27.0625	27.3125	30.1250	232.5000	228.8750	10.1250	10.3750	11.7500	12.0000
8	27.0625	27.3125	30.0000	232.6250	228.5000	10.1250	10.3750	11.8125	12.0000
11	27.3750	27.6250	30.5000	230.0000	226.5000	10.3750	10.5625	12.0000	12.1875
12	27.2500	27.5000	30.2500	229.3750	225.3750	10.3750	10.5625	12.0000	12.1875
13	27.0625	27.3125	30.0000	229.2500	225.2500	10.1875	10.3750	11.9375	12.1250
14	27.2500	27.5000	30.5000	227.5000	223.7500	10.1875	10.5000	11.9375	12.1875
15	27.2500	27.5000	30.2500	228.2500	224.7500	10.1875	10.5000	11.9375	12.1875
18	27.2500	27.5000	30.2500	229.5000	225.5000	10.1875	10.4375	12.1250	12.0625
19	27.5000	27.7500	30.5000	229.5000	225.7500	10.1875	10.4375	12.0000	12.1250
20	27.1875	27.5000	30.5000	228.8750	224.5000	10.2500	10.4375	11.8125	12.0000
21	27.1250	27.3750	30.3750	227.2500	224.0000	10.2500	10.4375	11.7500	11.9375
22	26.8750	27.1875	30.0000	224.5000	221.6250	10.2500	10.4375	11.8125	11.9375
25	26.1875	26.5000	29.2500	220.0000	216.7500	10.2500	10.3750	11.5625	11.6875
26	26.6875	27.0000	29.5000	214.7500	212.5000	10.3125	10.3125	11.6875	11.8125
27	27.3125	27.6250	30.6250	215.7500	212.5000	10.3125	10.3125	11.6875	11.8125
28	27.3750	27.7500	30.5000	215.0000	211.5000	10.3125	10.3125	11.4375	11.5625
Av. for month	27.175	.....	30.244	227.381	.....	10.216	10.413	11.819	12.000

Current Prices—Miscellaneous Metals, Ores, and Non-Metallic Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated.

(Mar. 1, 1935)

Miscellaneous Metals

Aluminum, ingot, 99 per cent plus, lb.	19@21c.
Antimony, domestic or Chinese (duty paid), lb.	14¼c.
Bismuth, ton lots, lb.	$1.10
Cadmium, lb.	55.00c.
Chromium, 97 per cent grade, lb.	88.00c.
Nickel, electrolytic cathodes, lb.	35.00c.
Magnesium, 99.8 per cent, carloads, lb.	30.00c.
Palladium, troy oz.	$24.00
Platinum, (official quotation) troy oz.	$34.00
Quicksilver, flask of 76 lb., 100 flasks or more	$72.50
Radium, mg. radium content	$50.00
Selenium, 99.5 per cent, lb.	$2.00
Silicon, minimum 97 per cent, spot, lb.	16.50c.
Tellurium, lb.	$2.00
Thallium, 100 lb. or more, lb.	$6.50
Titanium, 96 to 98 per cent, lb.	$6.00
Zirconium, commercially pure, lb.	$7.00

Metallic Ores

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45@47 per cent, c.i.f., long ton	$16.00@$16.50
Iron Ore, Lake Superior, long ton:	
Old Range bessemer	$4.80
Mesabi, bessemer	$4.65
Old Range, non-bessemer	$4.65
Mesabi, non-bessemer	$4.50
Lead (Galena) 80 per cent, Joplin, Mo., ton	$33.00
Manganese Ore, long ton unit:	
52@55 per cent	26c.
49@51 per cent	25c.
44@47 per cent	24c.
Molybdenum Ore, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	$16.50@$17
Domestic Scheelite	$16.50
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$26.00

Metallic Compounds

Arsenious Oxide (arsenic) lb.	3½c.
Cobalt Oxide, 70@71 per cent, lb.	$1.35
Copper Sulphate, 100 lb.	$3.85
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb.	$1.24
Sodium Sulphate, bulk, ton	$13.00@$15.00

Alloys

Beryllium-Copper, Master alloy, 3.5 per cent Be, per lb. of contained Be	$25.00
Ferrochrome, 65@70 per cent chromium, 4@6 per cent carbon, lb.	10c.
Ferromanganese, 78@82 per cent, gross ton	$85.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained	95c.
Ferrosilicon, 50 per cent, gross ton	$77.50
Ferrotungsten, 75@80 per cent, lb. of W contained	$1.35@$1.45

Non-Metallic Minerals

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$500@.....
Crude No. 2	$200@$225
Spinning fibers	$90@$135
Paper stock	$32.50@$37.50
Shorts	$11@$14.50
Vermont	
Shingle stock	$45@.....
Paper stock	$35@.....
Cement stock	$23@.....
Barytes, long ton:	
Georgia, crude	$7@.....
Missouri, 95 per cent $BaSO_4$, 1 per cent iron	$5@.....
Bauxite, long ton:	
Domestic, chemical, 55@58 per cent	$6@ $7.50
Domestic, abrasive, 78@84 per cent	$12.50@$15.00
Dalmatian, 50@55 per cent	(a)$4.50@ $6.00
French, 56@59 per cent	(a)$5.50@ $6.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$6.00@ $7.50
Delaware, No. 1	$14.00@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.50
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton	$13.50
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$22.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½x2 in.	15@30c.
2x2 in.	30@50c.
2x3 in.	50@65c.
3x4 in.	90@ $1.25
4x6 in.	$1.50@ $2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@ 12½c.
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$8.50@ $9.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$16.00@.....
200 mesh, cream colored	$26.00@.....

(a) Nominal.

Iron and Steel

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$19.00
Basic	$18.00
No. 2 Foundry	$18.50
Steel, base prices, Pittsburgh:	
Billets gross ton	$27.00
Structural shapes, 100 lb.	$1.80
Bars, 100 lb.	$1.80

MONTHLY AND YEARLY AVERAGE PRICES

Silver and Sterling Exchange

	New York		London Spot		Sterling Exchange	
	1934	1935	1934	1935	1934	1935
January	44.188	54.418	19.382	24.584	504.644	489.207
February	45.233	54.602	20.073	24.818	503.085	487.278
March	45.875	.....	20.278	.....	509.259	.....
April	45.180	.....	19.740	.....	515.210	.....
May	44.226	.....	19.276	.....	510.510	.....
June	45.173	.....	19.981	.....	504.721	.....
July	46.310	.....	20.512	.....	503.990	.....
August	48.986	.....	21.377	.....	506.398	.....
September	49.484	.....	21.888	.....	499.344	.....
October	52.375	.....	23.581	.....	494.019	.....
November	54.255	.....	24.257	.....	498.832	.....
December	54.390	.....	24.404	.....	494.520	.....
Year	47.973	.....	21.229	.....	503.711	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery, Electrolytic			London Spot			
	Domestic		Export	Standard		(a) Electrolytic	
	1934	1935	1935	1934	1935	1934	1935
January	7.890	8.775	6.583	32.560	28.077	35.614	31.261
February	7.777	8.775	6.341	33.072	27.175	35.969	30.244
March	7.775	.....	.....	32.497	.....	35.512	.....
April	8.173	.....	.....	33.006	.....	36.038	.....
May	8.275	.....	.....	32.662	.....	35.756	.....
June	8.594	.....	.....	32.149	.....	35.339	.....
July	8.775	.....	.....	29.707	.....	32.778	.....
August	8.775	.....	.....	28.358	.....	31.483	.....
September	8.775	.....	.....	27.541	.....	30.556	.....
October	8.775	.....	.....	26.753	.....	29.478	.....
November	8.775	.....	.....	27.233	.....	30.222	.....
December	8.775	.....	.....	27.836	.....	31.086	.....
Year	8.428	.....	.....	30.281	.....	33.319	.....

New York quotations, cents per pound. London, pounds sterling per long ton. (a) Bid quotation.

Lead

	New York		St. Louis		London			
	1934	1935	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January	4.000	3.692	3.900	3.542	11.304	11.517	10.321	10.514
February	4.000	3.528	3.900	3.378	11.634	11.913	10.216	10.413
March	4.000	.....	3.900	.....	11.545	11.842	.....	.....
April	4.179	.....	4.042	.....	11.500	11.794	.....	.....
May	4.140	.....	3.990	.....	11.051	11.341	.....	.....
June	3.975	.....	3.825	.....	11.054	11.253	.....	.....
July	3.772	.....	3.623	.....	10.813	11.045	.....	.....
August	3.747	.....	3.597	.....	10.821	11.028	.....	.....
September	3.685	.....	3.535	.....	10.388	10.613	.....	.....
October	3.654	.....	3.504	.....	10.359	10.554	.....	.....
November	3.567	.....	3.417	.....	10.432	10.597	.....	.....
December	3.604	.....	3.454	.....	10.316	10.500	.....	.....
Year	3.860	.....	3.724	.....	10.935	11.166	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	Straits New York		Standard, Spot London	
	1934	1935	1934	1935
January	51.891	50.916	226.631	231.193
February	51.668	50.063	226.731	227.381
March	53.838	.....	233.863	.....
April	55.622	.....	239.181	.....
May	53.541	.....	234.239	.....
June	51.271	.....	226.875	.....
July	51.930	.....	230.381	.....
August	51.953	.....	228.114	.....
September	51.503	.....	229.888	.....
October	50.951	.....	230.587	.....
November	51.227	.....	228.602	.....
December	50.902	.....	228.178	.....
Year	52.191	.....	230.273	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January	4.271	3.730	14.688	14.943	11.994	12.207
February	4.384	3.714	14.844	15.125	11.819	12.000
March	4.368	.....	14.735	15.033	.....	.....
April	4.370	.....	14.916	15.200	.....	.....
May	4.346	.....	14.722	14.966	.....	.....
June	4.240	.....	14.241	14.467	.....	.....
July	4.317	.....	13.466	13.693	.....	.....
August	4.281	.....	13.682	13.756	.....	.....
September	4.049	.....	12.644	12.847	.....	.....
October	3.832	.....	12.217	12.353	.....	.....
November	3.732	.....	12.000	12.281	.....	.....
December	3.711	.....	11.730	12.016	.....	.....
Year	4.158	.....	13.657	13.890	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1934	1935	(a) 1934	(b) 1935
January	55.000	55.000	23.300	20.000
February	55.000	55.000	23.300	20.000
March	55.000	.....	23.300	.....
April	55.000	.....	23.300	.....
May	55.000	.....	23.300	.....
June	55.000	.....	23.300	.....
July	55.000	.....	23.300	.....
August	55.000	.....	23.300	.....
September	55.000	.....	23.300	.....
October	55.000	.....	23.300	.....
November	55.000	.....	23.300	.....
December	55.000	.....	23.300	.....
Year	55.000	.....	23.300	.....

Aluminum in cents per pound, 99 per cent grade. (a) Based on Aluminum Company's quotation. (b) Open market price.
Cadmium, cents per pound.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1934	1935	1934	1935	1934	1935
January	7.198	14.111	67.538	72.760	38.000	34.000
February	7.172	14.250	72.011	72.500	38.000	34.000
March	7.545	.....	75.472	.....	38.000	.....
April	7.918	.....	75.930	.....	38.000	.....
May	8.465	.....	75.577	.....	36.538	.....
June	7.900	.....	75.000	.....	36.000	.....
July	8.024	.....	75.000	.....	36.000	.....
August	8.514	.....	75.000	.....	36.000	.....
September	8.745	.....	74.563	.....	36.000	.....
October	9.361	.....	74.000	.....	35.038	.....
November	12.239	.....	73.283	.....	35.000	.....
December	13.730	.....	73.000	.....	35.000	.....
Year	8.901	.....	73.865	.....	36.465	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1934	1935	1934	1935	1934	1935
January	18.00	19.00	17.00	18.00	17.50	18.50
February	18.00	19.00	17.00	18.00	17.50	18.50
March	18.00	.....	17.00	.....	17.50	.....
April	18.48	.....	17.48	.....	17.98	.....
May	19.00	.....	18.00	.....	18.50	.....
June	19.00	.....	18.00	.....	18.50	.....
July	19.00	.....	18.00	.....	19.50	.....
August	19.00	.....	18.00	.....	18.50	.....
September	19.00	.....	18.00	.....	18.50	.....
October	19.00	.....	18.00	.....	18.50	.....
November	19.00	.....	18.00	.....	18.50	.....
December	19.00	.....	18.00	.....	18.50	.....
Year	18.707	.....	17.707	.....	18.207	.....

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces.

H. C. PARMELEE
Editorial Director

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A. W. FISHER
Manager

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WILLARD CHEVALIER
Vice-President

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TIN SMELTING is something that Congressman Caldwell would like to see undertaken in the United States, his idea being to give the country a voice as to supply and price. But not so many years ago, five plants did business here and today are non-existent. As in making hare soup, one must first get his hare; so in smelting tin, a supply of ore and concentrates must be gotten somewhere.

•

SILVER HALF DOLLARS, of special design, authorized in 1934, were five in number, according to the latest report of the Director of the Bureau of the Mint. They were issued to commemorate the following: The Texas centennial of independence; the tercentennial of the founding of Maryland and Connecticut, respectively; Arkansas' centennial of statehood; and the 200th anniversary of the birth of Daniel Boone. Coins that not one person in a hundred has previously heard of or is even likely to see. Commemorative indeed, but not too effective as reminders.

•

ENGINEERING INDEX, an independent non-profit membership corporation, maintains a service that indexes and annotates 2,000 technical publications, from 40 countries in 20 languages. References go out daily or weekly to subscribers, as desired. Without this, much valuable information would stay hidden to a large part of the profession—frozen assets in unreachable libraries throughout the world. To meet its deficits, increase its usefulness, lower its price scale, the corporation's directors seek to raise a working capital fund of $161,000. A chance for philanthropists—individual or otherwise.

TAXES IN 1934 were 3,800,000 and net income before deducting them was $11,400,000, the ratio of the former to the latter being 33 per cent. Thus states American Smelting's last report. The ratio was 21 per cent in 1926; only 6 in 1913. A glance backward this, that causes forebodings as to the present and future trend.

•

POWER FACTOR puzzles many, or so it seems. Simple or not, it is most important, especially at an isolated a.c. plant that appears to be just carrying its present load and unable to take on any increase. By correcting a low factor, capacity can be increased without disturbing the balance of the system and at less expense than the installation of additional generators would entail. The subject will be discussed in simple language by two specialists in an early issue.

•

U. S. STEEL retired 921 employees in 1934. Some averages are—age, 61.33; years of service, 32.86; monthly stipend, $55.50. The names left on pension rolls on Dec. 31 totaled 12,316. This is cause for wishful thinking on the part of many, with respect to social insurance.

•

SMELTER STACKS help make skylines and are among the more imposing structures of the mining world. At times they appeal strongly to the eye and give the photographer an excellent chance to show his skill. The interest they have for *E.&M.J.* readers centers in their construction details. The most recent addition of this sort to metallurgical plants in this country is the new concrete chimney at Garfield, Utah. The building of it will be described next month.

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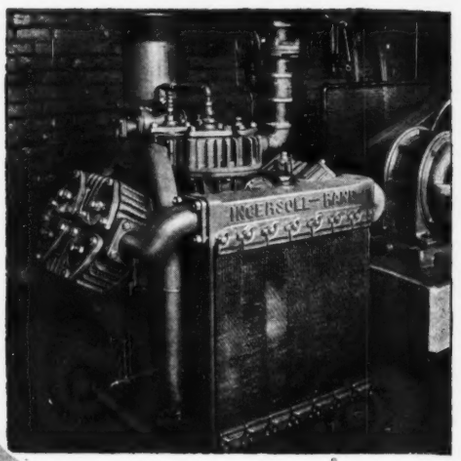

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